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CATALOGUE

OF THE

MADREPORARIAN CORALS

IN THE

BRITISH MUSEUM
(NATURAL HISTORY).

VOLUME V.

THE FAMILY PORITIDÆ.
II.—THE GENUS PORITES.

PART I.—PORITES OF THE INDO-PACIFIC REGION.

BY

HENRY M. BERNARD, M.A.

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PREFACE.

I REGRET the delay in the appearance of this volume, which I partly ascribe to the method of description employed in it, and partly to the great difficulty of the subject. Even now only the *Porites* of the Indo-Pacific region are described; but the second and concluding part of the Catalogue of this genus ought not to be long delayed.

The thanks of the Trustees are due to Professor Perrier and Dr. Ch. Gravier for enabling the Author to make a careful study of the splendid collection in the Museum of Natural History in Paris, which includes the types of Lamarck; and to Dr. T. Wayland Vaughan, of the U.S. Geological Survey, for enlarged photographs of specimens, with much useful information.

The volume has been carefully edited by Mr. F. Jeffrey Bell, the member of the permanent staff who has charge of the collection of recent corals; while advice with regard to matters of horizon in dealing with fossil forms has always been readily given to Mr. Bernard by Mr. R. Bullen Newton, of the Geological Department.

It is, of course, a matter for regret that the geographical arrangement of the forms proves so cumbrous and inconclusive, but I am not sorry that I allowed Mr. Bernard to try a new method, for the binomial is not one well adapted for corals. It is, however, convenient and generally adopted, and in returning to it, as we shall for other genera, we shall also, I hope, see much less sub-division of forms than we have had with *Goniopora* or *Porites*.

E. RAY LANKESTER.

British Museum (Natural History),
Cromwell Road,
London, S.W.
July 27th, 1905.

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ERRATA.

Page 31, fifth line from bottom, *read* 12–14 *instead of* 12–13.
„ 40, last line but one, *read* 6–9 *instead of* 6.
„ 95, *insert* on line with *a.*, Zool. Dep. 81. 1. 21. 7.
„ 103, last line but one, *read* 10 *instead of* 50.
„ 105, last line, *read* 24 *instead of* 4.
„ 108, last line but three, *read* 70 *instead of* 7.
„ 113, near middle of page, *read* 271 *instead of* 276.
„ 123, last line, *read* 325 *instead of* 3.
„ 131, middle, *insert* –219 *after* 218.
„ 142, last line, *read* 517 *instead of* 577.
„ 156, near bottom, *read* 94. 6. 16. 14 and 16 *instead of* 94. 6. 16 and 14.
„ 188, near middle, *insert—c.* Zool. Dep. 98. 12. 1. 30.
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CATALOGUE

OF

MADREPORARIA.

VOLUME V.

Part I.

PORITES OF THE INDO-PACIFIC AREA.*

The Genus PORITES.

(= *Porites* Dana; *Porites* + *Synaræa* Verrill; *Porites* + *Neoporites* + *Cosmoporites* Duchassaing and Michelotti; *Porites* + *Synaræa* + *Stylaræa* Klunzinger; *Porites* + *Synaræa* + *Napopora* Quelch.)

I. INTRODUCTORY REMARKS.

THE genus *Porites*, though confined to the warmer seas, is probably the most ubiquitous of all the Stony Corals. It is *par excellence* a reef builder, and on account of the closeness of its texture† and the minute size of its polyps, it is eminently adapted to build up the outer edges of the reef which have to encounter the surf. But though plentiful on reefs, it occurs here and there on shores where there are no reefs. In sheltered spots it builds up elegant branching stocks, and at first all *Porites* were thought to be branching; but immense solid masses are now known to be common. Mr. Saville-Kent‡ describes submerged rocks 20 feet in diameter, on which rich growths of other corals have settled, built up entirely by huge single colonies of these minute animals.

The genus is both geologically and morphologically a recent, that is, a Tertiary develop-

* Part II. will contain the Atlantic and West Indian forms.

† It is used for building purposes along the shores of the Red Sea (Forskål, Klunzinger), and in the Maldives (Gardiner).

‡ Great Barrier Reef, pp. 50, 185.

ment, and, with its allies the Madreporidæ, seems to stand now at the head of the system in the intricacy of its skeleton.

This intricacy has been such that it has hitherto puzzled all students of coral morphology. Milne-Edwards and Haime published a set of beautiful drawings * which they called "the structure of *Porites*," but they could give us no insight into what they drew. Miss Ogilvie † also attempted to elucidate the skeleton by means of ground plans, but her analysis rested upon too narrow a basis of comparison. Hence it follows that systematic workers who have hitherto tried to describe specimens, being without any insight into the probable or possible variations, have had to be content with the most superficial comparisons with previously described forms; and the difficulty of this lay in the fact that, though when closely examined, the specimens are all different, yet the nature of the differences it has been impossible to grasp. Hence the endless repetitions of a certain set of the earliest names.

Previous to the present writer, no workers, except, perhaps, Milne-Edwards and Haime, have had to study the genus comprehensively, and to establish by extensive comparisons of the related genera, and of great numbers of forms within the genus, what are the essential principles of its structure. Such a study is necessary before any insight can be gained into the variations. It was imposed upon the present writer when he undertook to continue this series of volumes dealing with the Stony Corals.

In spite of the fact that the work in the earlier volumes, especially in Vol. IV., had already afforded considerable insight into the fundamental plan of structure of the Poritidæ, the difficulties presented by the skeleton in *Porites*, with its minute calicles, were most discouraging. So great, indeed, is its apparent complexity, showing so many subtle differences which baffle all attempts to define or even to describe, that the student stands long before the task in despair. A beginning of some kind had to be made and attempts at description prepared, though with hardly any insight into the inter-relationships of the parts. Slowly this uphill work revealed certain constant features. From this vantage ground the descriptions were all re-written, when again new points came to light, and so on: each time of re-writing fresh principles of structure were discovered, and finally the descriptions had all to be done over again. The systematic portion of this volume has been written out *in extenso* at least four times, with the result that the intricate skeleton of this genus can now be reduced to order, and the principles of structure minutely described, although we are still far from having unravelled the exact nature of many of the variations.

As one illustration of this gradual dawning of the facts, let me cite the case of the pali. These are the most conspicuous elements in the calicle; they have been recognised by every worker since the middle of the last century: yet it was only after the present writer had written out his first draft descriptions of the whole of the Museum collection that they were found to be arranged upon a definite plan. And now, again, it is only as this volume is going to press, and when too late to alter the descriptions, that some of the relations of these

* Ann. Sci. Nat., xvi. (1851) pl. i.

† Phil. Trans., clxxxvii. p. 219.

pali to the rest of the skeleton have come to light as one of the results of the summing up and critical analysis of the facts prepared expressly for this Introduction.

And yet, after all this uphill work, the reader who masters the account given in Sec. III. of the morphology of the skeleton will find it simple enough, and it may be a wonder to him that the task was so hard, taking months and even years to accomplish. That is, however, the fact. There were, indeed, moments near the beginning of it when the writer was in despair, and on the verge of resigning his undertaking altogether.

The method of treating the variations which the writer has been able to describe will be discussed on p. 25; compare also Vol. IV., pp. 3, 31, 190.

II. HISTORICAL.

(*a*) Porites.

The generic name was first given by Link (Naturalien Samml. Rostock, 1807, p. 163), and the genus consisted of "branching" corals "covered all over with scattered, stellate, flaky (blättrigen) openings." He cites two species: *P. polymorphus*, a term which explains itself, and *P. damicornis*, which is a *Pocillopora*.

Prior to this, Pallas (Elenchus, 1766, p. 324) grouped under the name *Madrepora porites* a heterogeneous assortment which he had seen actually or in figures. There is no record of the specimens actually seen, and with the exception of one or two of the cited figures, the corals they were intended to represent cannot now be identified. That figured by Seba (Thes., iii., p. 109, fig. 11) from Curaçoa, with the locality to help, may be rediscovered. The figures given by Sloane (Jamaica I., 1707, pl. xviii., fig. 4) and by Morrison (Hist. Plant. iii., 1699, section 15, pl. x.) may be true *Porites*. Of the names quoted by Pallas, the *Madrepora punctata* Linn. has generally been thought to refer to a member of this genus, but, in the absence of any figure, it is not now possible to say. The question is discussed in the systematic part, see, e.g., under the heading *P. moluccas 1.*

In 1775 Forskål, in an account of the corals found on the shores of Arabia, noticed some used as building material, which he called "*Madrepora solida*," with a variety "*fragilia*." Milne-Edwards referred them to the genus *Goniastræa*, but Dr. Klunzinger claims them as *Porites*, viz., *P. solida* Forskål and *P. lutea* Klz.

In 1786 Ellis and Solander published one excellent figure (pl. xlvii. fig. 1) of a *Porites*, as *M. porites* of Pallas, without locality, and another (pl. xli. fig. 4) which has been often taken for a *Porites*, but it may be many things, and it is idle to continue the process of guessing.

To the two best figures of *Porites* above mentioned, viz., those of Seba and Ellis, Esper added five coloured figures of Poritids, four of which ought to take their places among known forms assumed by the genus *Porites*. His pls. xxi. and xxiA are two distinct forms, though placed under *M. porites*. Pls. lix. and lixA respectively represent a branching *Goniopora* and a

glomerate *Porites* grouped under one name, *M. conglomerata*, while on pl. lxv. there is figured a thin, encrusting form, called by Esper *M. arenosa* Linn. In addition to these four, two doubtful figures are given, *M. contigua* (pl. lxvi.) and *M. punctata* (pl. lxx.). All these are referred to in the systematic part.

Then in 1807, as stated, Link established the genus *Porites*, believing all the forms to be branching, with a single species, *P. polymorphus*. In 1816, however, Lamarck, without mentioning Link, gave a list of sixteen "species" under the generic name *Porites*. Only five of them really belong to the genus, but as two of these have "varieties," Lamarck altogether described eight forms. He improved on Link's very brief description. The members of the genus were not only branching, but "fixed, branching, lobate or obtuse, with the free upper surface everywhere covered with the calicles, which are regular, subcontiguous, superficial or excavated, with either no margin or else a very imperfect one, septa filamentous, pointed or cuspidate." This description must be discounted by the fact that Lamarck included in the genus specimens of *Alveopora*, *Stylophora* and *Montipora*. He added in a note that flattened and encrusting forms occur, which was not apparent from his description, but could be seen by his including Esper's *M. arenosa* (= *P. "arenacea"* Lam.).

In 1820, Lesueur * discovered and figured for the first time the living polyps of certain *Porites*—five forms in all, two of which he thought were the same species as two of Lamarck's *P. astreoides* and *P. clavaria*.

In 1830 † and 1834 ‡ De Blainville curtailed the genus by removing the specimens of *Alveopora* and part of the *Montipora*, which Lamarck had included. One true *Porites* (*P. furcata* Lam.) he wrongly moved to the genus *Heliopora*. He left only four true *Porites*, having dropped the two varieties of *P. clavaria*. His description of the genus was, however, so far improved that he added what Lesueur had discovered, that the animals were urceoliform, with twelve short tentacles, and also that the calicles were shallow, polygonal, irregular, and unequal. No mention is made of the very characteristic pali, apparently because he took *P. astreoides* as a type (see his figure, pl. lxi., with an enlargement).

The genus, he thought, could not be an Astræid on account of the perforate septa, nor a Madreporid, because the calicles were shallow: it formed a kind of transition between the two, but it was nearer to the latter.

In 1834, Quoy and Gaimard § described new forms, but threw no further light on the genus.

But in the same year Ehrenberg ‖ came much nearer to a natural classification. As one of his "meshwork corals," *Porites* came near *Madrepora* (*Heteropora* Ehr.). But not having *leading* calicles (hence the name *Heteropora*) it was classed with *Astræopora*, which with *Porites* formed two sub-genera of his "*Madrepora*." *Astræopora* (*Phyllopora* Ehr.) differed from *Porites* in having the septa complete, whereas in the latter they were rows of points or teeth. These

* Mém. Mus. Paris, vi., p. 21. † Dict. Sci. Nat., lx., p. 360. ‡ Manuel, p. 395.
§ Voyage de l'Astrolabe, iv. Zoophytes, p. 249. ‖ Korallenthiere, p. 115.

points or teeth did not, apparently, refer to the pali of *Porites*, but rather to the vertical rows of points which he saw representing the septa in the eight *Montiporæ* included in his list of nineteen species, only one or two being, perhaps, true *Porites*, viz. the enigmatical *P. punctata* Ehr. (see below *P. mülleri*), and one of his varieties (see *P. nodifera* Klz.).

Ehrenberg's classification, based solely upon the method of budding, explains his having merged *Montipora* into *Porites*, an error only partially rectified by Milne-Edwards and Haime (see this Catalogue Vol. III. pp. 4, 5).

In 1848, Dana's "Zoophytes" appeared, and the genus *Porites* was united with *Goniopora*, the two forming the family Poritidæ. For a description of the structure and position of this family, see our Vol. IV., pp. 27, 28. *Porites*, according to Dana, differed from *Goniopora* in having smaller calicles, with only 12 septa.

Porites was further characterised by the circle of 5–6 pali round a central point or "pore," often surrounded by an outer ring of granules, combinations of one inner and two outer, frequently forming V-shaped pali. Twenty-four species occur in Dana's list, divided primarily according to growth form: 1. Ramose, (*a*) with branches compressed, not plicate, (*b*) with branches plicate. 2. Glomerate. 3. Thin encrusting. These were again divided into those with calicles (*a*) excavate, (*b*) superficial.

In 1851, Milne-Edwards and Haime * published their monograph of the Poritidæ, and, as described in Vol. IV., p. 4, diagnosed the family and the genus on an entirely false principle. The genus *Porites* itself is well, though insufficiently, described, and an excellent plate is given with enlarged figures to show "the structure of *Porites*" and drawn from a few of the more crowded branches of one of the original specimens of "*P. furcata*" of Lamarck, still preserved in the Paris Museum. The ring of "5–6, sometimes more" pali, is noted, with the observation that they seem hardly distinguishable from the septa ("cloisons . . . peu distinctes des palis"). The central columellar tubercle is also mentioned. For Milne-Edwards ("Les Coralliaires" iii. (1860) p. 173) the genus consisted of twenty-seven recent and one fossil "species." They are divided primarily according to growth-form. Other lines of division were based upon the development of the columella and the thickness of the walls. The four last "species," taken from Dana, are marked as doubtful members of the genus. They were transferred to a new genus, *Synaræa*, by Dr. Verrill (see below, p. 9).

In 1860, Duchassaing and Michelotti † described new specimens from the West Indies, while in a supplement (1864) they classified the specimens, dividing them into three genera: (1) *Porites*, with pali, and most often ramose ("sæpissime ramosæ"); (2) *Neoporites*, with calicles deep and pali suppressed; (3) *Cosmoporites*, differing only in growth-form from *Neoporites*, being "repentes incrustantes," instead of "incrustantes tuberosæ vel etiam lobatæ." These divisions have, as we shall see, found no favour,‡ and, for reasons which will be found below (p. 10), are not accepted in this Catalogue.

* Ann. Sci. Nat. (3°) xvi. p. 21.

† Mém. sur les Cor. des Antilles, Turin, p. 82.

‡ Pourtales, in his notice on Florida reef corals, thought *Neoporites* a good sub-genus.

In 1864,* Dr. Verrill founded a new genus, *Synaræa*, for those of Dana's *Porites* in which the calicles were flush with the surface (see, however, p. 9).

In 1866, Dr. Verrill† described several new species from the West Coast of America. According to him the genus consisted of Poritids "having generally 12 septa, sometimes 12 to 20, rarely 24." In this catalogue all Poritids with more than 12 septa are placed in the genus *Goniopora*. Dr. Verrill noted the circle of 5–6, or more, small papillæ, or paliform teeth, often scarcely distinct from the septal papillæ.

In 1871, Pourtales‡ recorded the great abundance of forms which he called by the old Lamarckian names "*furcata*," "*clavaria*," and "*astræoides*," on the Florida reefs.

In 1878,§ Brüggemann, in describing a new "species," complained of the reckless way in which certain "specific" names—e.g. "*Astræoides*" and "*arenosa*"—had been applied, and made special reference to the misapplication of the name "*conglomerata*."

In the following year,‖ in a posthumous paper, the same writer described two new forms from Ponapé.

In 1879, Dr. Klunzinger¶ described and photographed some of the Red Sea forms. Starting from a proposition that in *Porites* the calicles are joined together by walls and not by cœnenchyma, an untenable distinction already criticised in Vol. IV., pp. 6 and 19, of this Catalogue, he separated *Synaræa* as far as possible from *Porites*, whereas, in this Catalogue, it has been found impossible to separate them. Most Porites are Synaræas round their basal edges, where the calicles are usually flush with the surface.

Dr. Klunzinger recognised the pali as the lowest or innermost of the septal teeth (see further, below, under *Stylaræa*, p. 11).

In 1880, Agassiz** published excellent figures of "*P. clavaria*," "*P. furcata*" and "*P. astræoides*." The detailed figures of his "*P. furcata*" are very different from those given by Milne-Edwards and Haime mentioned above.

In 1884, Martin Duncan†† described the genus without making any advance on Milne-Edwards and Haime. He repeated Dr. Klunzinger's statement above referred to, as to the distinction between *Porites* and *Synaræa*.

In 1886, Mr. Quelch, in describing the 'Challenger' Reef Corals,‡‡ was led to believe that two cycles of septa were not characteristic of *Porites*. Although quoting Dr. Verrill (see above), he was himself led to this on finding a Philippine specimen, named by him *P. mirabilis*, which had a large number of calicles with three and even four cycles. The fact, however, was overlooked that such abnormal double calicles occur very commonly in nearly all *Porites*. I have found them also in *Turbinaria* and *Montipora*. In the case of *P. mirabilis*, they happen to be especially numerous, but on no account do they justify any alteration in the usual description of *Porites*.

* Bull. Mus. Comp. Zool., i. p. 42.
† Trans. Conn. Acad., i. (1866) p. 505.
‡ Mem. Mus. Comp. Zool. (1871), p. 84.
§ Abh. Bremen, v. p. 546.
‖ Journ. Mus. Godeffroy, v. p. 210.
¶ Die Korallthiere des Rothen Meeres, ii. p. 39.
** Mem. Mus. Comp. Zool. Harvard, pl. xii. figs. 4–7; pl. xvi. figs. 1–22.
†† Journ. Linn. Soc., xviii. p. 187.
‡‡ Chall. Rep. xvi. p. 178.

The 'Challenger' Collection was said to yield seven new "species." But, daring here to look beyond these imaginary groups, we find that the whole number of the *forms* discovered are definite additions to our knowledge of the genus.

In 1887, Dr. Rathbun * catalogued the *Porites* in the United States National Museum, and described one as new. He calls attention to the fact that all Dana's types except two are in the collection. It is to be hoped that good photographs will, ere long, be published in order to supplement Dana's drawings and descriptions which, though excellent when published, are now quite inadequate for purposes of identification. Figures of different forms *assumed* by *Porites* "*clavaria*" and "*P. furcata*" are given, and their extended distribution, coupled with the great difficulty of distinguishing between them, is commented on.

In 1888, Dr. Ortmann † described the corals in the Strasburg Museum, with special reference to geographical distribution. They were all "identified" with many "species" already described. As all such identifications of small collections are necessarily guesswork, a geographical distribution of the "species" only means the distribution of the forms to which the same names have been given.

In 1889, the same writer ‡ gave a description of the genus in terms of his new system of classification. The calicles are said to be small, circumscribed, since the cœnenchyma is compressed to thin or moderately thick polygonal, porous false-walls.§ There are, further, said to be 5–6 pali-like granules on the septa. Again, the specimens from Ceylon, collected by Professor Haeckel, were all referred to recorded "species." In 1892 (Zool. Jahrb., vi.), a new "species" was described by Dr. Ortmann from the East Coast of Africa.

In 1892,‖ Dr. Rehberg described the corals in the Hamburg Museum. In two cases he gives the masculine termination to the specific name, *P. solidus* Forsk., *P. profundus* Rehberg. Two new "species" were described.

In 1895, Professor Gregory ¶ discussed the three Lamarckian names, *clavaria*, *furcata*, and *astræoides*, arriving at conclusions which will be dealt with in Part II. of this volume.

In 1896, Miss Ogilvie ** made a bold attempt to analyse the morphology of the Madreporarian system on practically one leading character—viz. the fine structure of the septa. *Porites* is frequently mentioned, but the problem of its position was finally given up as insoluble.

The author (l. c. 218) described the skeleton, and figured ground-plans showing the relation of septa, costæ and zigzag synapticular walls in two forms. No wide range of specimens, however, were examined; hence the description is not, at least as far as the thin zigzag wall is concerned, applicable to the whole genus, while the septal formula is incorrect. Figures showing the minute texture of the skeleton are also given. With regard to Miss

* Proc. U.S. Nat. Mus., x. p. 358. † Zool. Jahrb., iii. (syst.) p. 143.

‡ Zool Jahrb., iv. (syst.) p. 500.

§ The term "false-wall" is apparently not used here as equivalent to the condition implied in the term "Pseudo-thecalia," but rather to that implied in Dr. Ortmann's term "Athecalia."

‖ Abh. Nat. Verein Hamburg, xii. heft. 1, p. 46.

¶ Quart. Journ. Geol. Soc., li. p. 282. ** Phil. Trans., clxxxvii. p. 88.

Ogilvie's uncertainty as to where the genus should really be placed, on p. 223 it is thought to be an extreme form of the Madreporaria Perforata, but on p. 328 doubts are raised as to whether it can be united with the Cœnenchymata (= Madreporids) at all.

In 1898, two separate accounts of the *Porites* collected at Funafuti appeared, one by Mr. Stanley Gardiner * and the other by Dr. T. Whitelegge,† of the Australian Museum, Sydney. The former records some eleven forms (from Funafuti, Rotuma, and Wakaya, Fiji); of these, eight were described as hitherto unknown forms. Dr. Whitelegge records seven, all from Funafuti, and gives them all old specific names. It is impossible to say how far Dr. Whitelegge's collection overlapped Mr. Gardiner's. Old specific names alone given to specimens of *Porites* tell us, unfortunately, nothing about them, and even brief descriptions, unless with illustrations, are of little value. Only elaborate and well illustrated descriptions can help us in dealing with so difficult and intricate a group.

In 1899, the present writer ‡ discussed the position of the Poritidæ, and therefore of *Porites*. A description of their structural characters, as compared with the rest of the Madreporaria, and based solely upon an analysis of the skeleton, led him to the conclusion, that the *Porites* were dwarfed Madreporids, and that *Goniopora* might be deduced from *Porites* by secondary enlargement.

In the same year, § however, the discovery of the bilateral symmetry in, and the true septal formula of *Porites*, and of the fact that the latter could be deduced from that of *Goniopora* by a process of reduction (see below, p. 13, diagram), led him to regard *Goniopora* as the more primitive.

The discovery was made at the same time that the pali, which had hitherto been regarded as a simple cluster of points or granules, in reality appear according to certain definite plans as to size and number, thus supplying an entirely new character for the systematic treatment of the genus. The analysis of the palic formula has been carried much further in this volume (see p. 18).

Many references to this genus occur also in Vol. IV. of this Catalogue.

In 1901, Professor Studer ‖ described new *Porites* from the Pacific area, well illustrated by photography, and thus of permanent value.

Dr. Wayland Vaughan ¶ has done similar service to our knowledge of the West Indian forms, also published in the same year in connection with the United States Geological Survey. This work will be noticed again in Part II., which will deal especially with that group.

In 1902, Dr. Duerden ** published an account of the West Indian Madreporaria, both anatomical and histological. It contains a special account of a West Indian form supposed to be specifically identical with that which Lamarck called *Porites astræoides*.

* Proc. Zool. Soc., p. 257.
† Mem. III., part 6, of the Australian Museum, p. 349.
‡ Journ. Linn. Soc., xxvii. p. 127.
§ Op. cit., p. 487.
‖ Zool. Jahrb. xiv. (syst.) p. 388.
¶ Bull. U.S. Fish Commission, ii. p. 314.
** Mem. Nat. Acad. Sci., Washington, viii.

(*b*) Synaræa.

This genus was founded to include those forms described by Dana among his *Porites*, with regard to which Milne-Edwards and Haime had expressed doubts in their "Monographie des Poritides," by notes of interrogation. These doubts were repeated by Milne-Edwards in the third volume of "Les Coralliaires" in 1860. Acting apparently on this suggestion, Dr. Verrill * described the new genus as follows:—

The corallum is irregularly branched or glomerated, the cells without distinct walls, the septa rudimentary. Six prominent paliform lobes surround the central cavity, which has a rudimentary or very small trabecular columella; outside of the pali are other similar points or granulations scattered between the cells which are not distinctly circumscribed, but often separated for some distance by a porous cœnenchyma.

In addition to the corals called by Dana *Porites crosa*, *P. informis*, *P. monticulosa*, and *P. contigua* (= *P. danæ* M.-E. & H.), Dr. Verrill described three as new "species."

All subsequent writers on the Poritids have accepted this genus, without serious alterations in the description. Dr. Klunzinger (1879),† writing from the current point of view that the compound stony corals were built up by the secondary fusions of their walls, describes the difference between *Synaræa* and *Porites*—that the former are united by cœnenchyma, the latter directly by their walls. On this diagnosis, however, compare Vol. IV., p. 19. He consequently placed *Synaræa* by itself at the end of the Poritids, that is, after *Goniopora* and *Alveopora*, which at that time was thought to be a Poritid.

Martin Duncan (1884), in his attempted revision of the Milne-Edwards classification, repeated Dr. Klunzinger's diagnosis, but again brought *Synaræa* into close proximity with *Porites*.

The present writer, in 1899,‡ expressed doubts as to whether *Synaræa* showed any real generic distinction from *Porites*. The subject was followed up incidentally in a second paper,§ while in Vol. IV. of this Catalogue *Synaræa* is definitely merged in *Porites*.

The reasons may be summed up as follows: The distinction is not fundamental—that is, there is no real variation in plan as there is, for instance, between *Goniopora* and *Porites*. The differences are matters only of degree. The forms in which the intra-calicular skeleton rises up to the level of the wall have just as much right to be included in the genus as have those showing the other extreme, in which the calicular skeletal elements are deeply sunk, which is the supposed generic character of *Neoporites* and *Stylaræa*. Every intervening stage can be seen without any real difference in the essential plan of structure. Indeed, the matter is put beyond dispute by the fact that in a very large number of typical *Porites* all the calicles down the sides and on the under surfaces are typical of the supposed new genus *Synaræa*.

* Bulletin Mus. Comp. Zool. Camb. Mass. (1864) iii. p. 42.

† Die Korallthiere des Rothen Meeres, ii. p. 39.

‡ Journ. Linn. Soc., xviii. p. 187.

§ *Tom. cit.*, xxvii. pp. 127, 487.

Further, as will be seen in the section on the morphology of the skeleton, a special prominence of the pali, supposed to be characteristic of *Synaræa*, is the rule in shallow calicles. And specimens may be seen with deep calicles and feeble pali, supposed to be typical of *Porites*, on the top, but down the sides the calicles are shallow, and the pali very pronounced.

An exactly parallel phenomenon was pointed out in Vol. IV., p. 16. Deep calicles, supposed to be typical of *Goniopora*, may be seen over all the upper parts of a stock, while shallow calicles with very prominent central rosette, thought to be typical of the genus *Rhodaræa*, may be found at the sides. The genus *Synaræa* is suppressed for reasons similar to those which compelled us to suppress the genus *Rhodaræa*.

(*c*) Neoporites et Cosmoporites.

These genera were the result of the working up in 1864 * by Duchassaing and Michelotti of the collection of corals from the Antilles, which they had roughly described in 1860.†

The earlier description resulted in nine "species," five of which were thought to be new. The elaboration of the collection resulted in thirteen species divided among three genera—*Porites*, *Neoporites* and *Cosmoporites*. The first genus contained the branching forms. The second differed from the first in being encrusting, tuberous, or even lobate, and in having no pali, or only vestiges of them. The third is also encrusting, and seems to differ from the second genus only in having a small reticular columella (*columella laxa*).

The uncertainty of the genus *Neoporites* has been pointed out by several authors. Martin Duncan ignored both it and *Cosmoporites*, in his revision. Dr. Gregory ‡ placed *Neoporites* in the synonymy of *Porites astræoides*, but made no mention of *Cosmoporites*. The same applies also to Dr. Wayland Vaughan.§

The present writer pointed out ‖ that the difference between *Porites* and these new genera was practically the difference between the ordinary *Porites* with septa fusing and sending up pali, and the forms with short septa which do not meet, and thus have no pali. The best known representative of such forms at the time was the *P. astræoides* of the West Indies. Since writing that, many forms have been found in the Indo-Pacific area which show the same apparent simplicity of the septa. This septal arrangement now, however, seems to be correlated with the depth of the calicles; when the latter are shallow, the septa meet and fuse high up, and pali rise from the points of fusion. But as the calicles deepen, the septa slope downwards, separately, and their points of fusion and of pali formation are gradually mixed up with the columellar tangle, until we have a return to what appears to have been the most primitive condition of twelve short separate septa. Compare further the discussion on *Stylaræa* below. The two genera *Neoporites* and *Cosmoporites*, as distinct from *Porites*, do not, then,

* Mem. Acad. Sci. Turin, xxiii. pp. 1–112. † *Ibid.*, xix. pp. 1–89.
‡ Quart. Journ. Geol. Soc., li. (1895) p. 284.
§ Samml. Geol. Reichs Museum, Leiden 2°, ii. (1901) p. 75.
‖ Journ. Linn. Soc., xxvii. (1899), p. 147.

represent any structural difference of generic importance. They fall within the range of ordinary variations.

As to the difference between *Neoporites* and *Cosmoporites*, the authors were not sufficiently explicit. They seem to have referred to some slight variation in the character of the columellar tangle, which can safely be dismissed as of no generic value.

(*d*) Stylaræa.

This genus was first established by Milne-Edwards and Haime,* in the year 1851, for a coral from some unknown locality found in the Berlin Museum, and previously named by Ehrenberg † *Porites punctata* Linnæus and Esper. A glance at Esper's figure showed that that identification at least was incorrect. The name was therefore changed to *Stylaræa Mülleri*. In the same year, however, in their "Monographie des Poritides," ‡ they went back to Ehrenberg's designation. This was adhered to in "Les Coralliaires" in 1860.

The next reference to the genus was by Dr. Klunzinger, who had to deal with the same specimen. This writer united it with Ehrenberg's No. 17 *Porites arenacea*, probably a young colony from the Red Sea, and with specimens of his own, also from the Red Sea, and for these he revived the genus *Stylaræa*, calling the specimens *S. punctata* § (see under the Red Sea forms).

The genus is said to differ from *Porites* in having few septa, no pali, and well developed columella, in some respects even resembling a *Stylophora*. Dr. Klunzinger's excellent photograph of one of his own specimens comes to our help. An examination shows that these characters are very irregular. Dismissing the absence of pali as a well-known character of deep calicles, we turn to the columella; this we find is uncertain in appearance, and variable in shape, while lastly the septa are so devoid of all symmetry, here developed, there not, that the specimen appears to us to be simply a young *Porites* colony with calicles so crowded as to be incomplete. This irregularity and incompleteness of very young calicles, whether appearing among adults, or forming by themselves a young stock, is frequently seen. All Dr. Klunzinger's specimens were, I believe, young colonies, as were those described by Ehrenberg.

The genus, therefore, requires a much firmer foundation before it can be considered as established. Specimens must be found in which a type of calicle can be seen, at least as definite as those of adult specimens of *Porites*, for in them, no matter how small and intricate the skeletal pattern may be, an unmistakable uniformity is always visible. It is the absence of this uniformity which compels me to regard the specimens on which Dr. Klunzinger relies as young colonies of immature individuals with irregular only half-formed skeletons.

* Poly. foss. der ter. paléozoiques, p. 143.
† Korallthiere des Rothen Meeres, p. 118, No. 17.
‡ Ann. Sci. Nat., xvi. p. 30.
§ Korallthiere des Rothen Meeres, ii. (1879) p. 44.

(*e*) Napopora.

This genus was established by Mr. Quelch * for a specimen of *Porites*, which was brought back by H.M.S. 'Challenger' from Tahiti. It is not only a cœnenchymatous form like those formerly included in *Synaræa*, but the porous intervening tissue mounts into ramparts. Swellings of the cœnenchyma were already known, e.g. in Dr. Klunzinger's *Synaræa* (= *Porites*) *undulata*. But these were unusual, and Mr. Quelch was misled into describing the coral as showing "intra-calicinal gemmation," and "almost a meandrine condition." At the same time, however, Mr. Quelch remarked upon a resemblance of the form to one of his own "species" of *Porites* (*latistellata*). Newly acquired specimens have now indeed established beyond doubt that the type of the genus is merely a specimen of this same "species" (see *P. Society Islands 2*), and consequently the genus falls back into *Porites*.

In the meantime the genus had been accepted by Martin Duncan in 1884,† but was merged with *Porites* in 1899 ‡ by the present writer.

III. MORPHOLOGY OF THE SKELETON.

The general description of the Poritid skeleton has been given in detail in Vol. IV., pp. 18 et seq., and it will apply here. A very brief summary of it must therefore suffice, for our chief duty is to explain the special characters of the genus *Porites*. The Prototheca § in the Poritids, as in the Madreporidæ, is early flattened out, and the perforate septal plates rising from the epitheca are joined by synapticular bars so as to form a reticular theca. The cavity of this theca is filled up more or less completely with tissue derived from the fusions of bars or teeth from the septal edges with a central trabecula, and these with the occasional development of synapticulæ forming rings round the fossa together constitute a columellar tangle. This may fill up the whole theca, or leave a cup-like depression of varying depth. This description applies equally to *Porites* and to *Goniopora*.

The skeleton of *Porites* differs from that of *Goniopora* mainly in the fact that, the former has only twelve septal plates, while the latter has typically twenty-four. But suppression of septa, owing to the diminution in the size of the calicles, may reduce the latter number to from twelve to fourteen. No accidental and irregular reduction, even to twelve septa, can, however, turn a *Goniopora* into a *Porites*; for though the septal formula of the latter can be deduced from that of the former, the manner of the reduction is formal and regular. This is shown in the accompanying Diagrams (fig. 1).

The point is of importance, for many small-calicled *Gonioporæ* are mistaken for *Porites*, and

* Ann. and Mag. Nat. Hist., xiii. (1884) p. 296.

† Journ. Linn. Soc., xviii. p. 187. ‡ Op. cit., xxvii. p. 143.

§ For a detailed account of the use of this term, see Ann. and Mag. Nat. Hist., xiii. (1904) pp. 1–33.

hitherto there has been no possible means of deciding to which genus they belong. A comparison between the two septal formulæ will now enable us to decide. If the twelve septa conform to Diagram B, then it is a *Porites*; if, however, it is an irregular reduction of Diagram A, it is a *Goniopora*. The irregularity is seen most frequently in apparent forkings of the septa before they reach the wall—such a forking as, for instance, we should get if, say, in Diagram A any of the tridents made by the 2nd and 3rd cycles lost their middle prongs. The typical septal formula of *Porites* is that shown in Diagram B, that is, if we omit the rudimentary tertiaries inserted in the drawing for the purpose of making the suppression clear.

If the reticular theca is regularly built, we can trace two systems of elements in its structure; firstly, the vertical bars, to which the name trabeculæ is here strictly confined;* and secondly, the horizontal bars, or horizontal elements or junctions, as they are called in this book. These latter are again divisible into (*a*) radial bars, original components of the septal plates; and (*b*) concentric bars, usually called "synapticulæ."

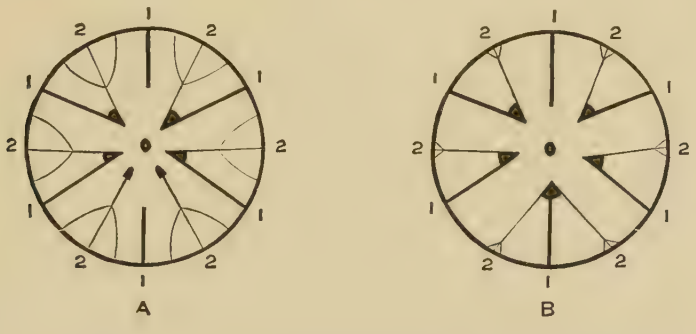

FIG. 1.—Diagrams to show how the septal formula of *Porites* (B) † may be derived from that of *Goniopora* (A) by the degeneration of the tertiary septa.

The whole skeleton is built of these elements; their various groupings, comparative developments, and appearances at the growing surface supply us with all the systematic characters which the skeleton affords us. Whether these elements are true morphological units, or mere arrangements of tissue, is a difficult question, which I think must be decided in favour of the latter alternative.‡ But the point may be raised as to whether even what are mere arrangements of tissue, if repeated often enough, do not gradually acquire a morphological significance of their own, and whether, in the present case, this has not happened. This is a point which the next comprehensive study of the genus must decide. The attempt to do so here is out of the question. This volume is now complete; it has

* On the earlier use of this term, see Vol. IV. pp. 4, 18.

† See remark on this Diagram on p. 24.

‡ This point was discussed in the Journ. Linn. Soc., xxvii. p. 138.

cleared our knowledge of the genus from many entanglements, but if it stays to solve all the questions which crop up, and will continue to crop up, it will never be finished.

As the matter stands at present, the great bulk of the *Porites*, taking the inner aspect of the theca alone into account, seem to have the elements arranged as in Diagrams A, B, fig. 2. A shows an ideal vertical section, from wall trabecula to wall trabecula (*w*), and B is the ground plan of the same, with the trabeculæ cut across and the horizontal junctions shown

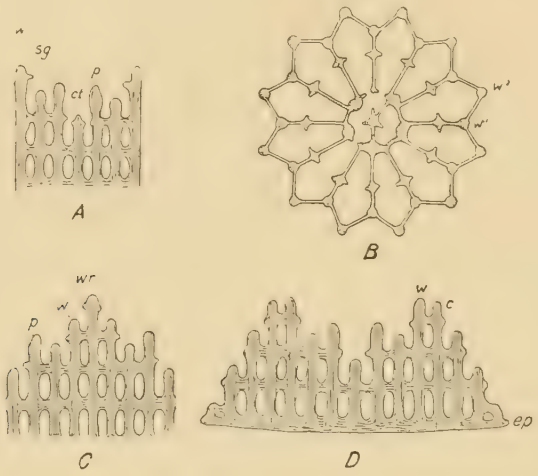

FIG. 2.—Diagrams illustrating the structure of the theca of *Porites*. A, an ideal vertical section through a simple walled calicle of a colony; *w*, the wall trabecula; *sg*, the septal granule; *p*, the palus; *ct*, the central tubercle (these three are seen, like *w*, to be the tips of trabeculæ). B, a horizontal section of a calicle in a colony in which the thecæ are slightly separated so that the synapticulæ joining the wall trabeculæ (w^1) with those of adjacent calicles (w^2) have a zigzag course. C, a vertical section through a compound wall, which appears when the simple walls (*w*) are far enough apart to admit of an intervening trabecula, in this case figured as rising above the walls (*w*) as a wall-ridge (*wr*), making *w* look like another granule of the septal edge (the "wall granule"). D, an ideal parent calicle to explain the origin of intervening trabeculæ; they are homologous with costal trabeculæ (*c*), one or more of which are able to appear if the calicles in a colony are far enough apart to admit them; *ep*, epithecal saucer or prototheca.

for the most part as if complete, although those of the wall and septa are usually interrupted by perforations seen in the septa in A. The radial junctions seen in B are septal; the concentric junctions forming the wall, and running here and there between the pali, and, again, as if starting, but seldom meeting, between the septal granules, are synapticular.

This is apparently the simplest and commonest type of structure met with in *Porites*, so far as the inner aspect of the theca is concerned. And though nearly all *Porites* appear alike

at first sight and to the uninitiated, the possibilities of variation are in reality endless. We not only have variations of this simple pattern within itself, that is without altering its essential structure, but we have possibilities of slight changes in its essential structure which do not seem to take us far enough away to warrant the founding of a new genus. This latter restraint is the more felt because it is doubtful how far we can treat the elements of which the pattern is composed as morphological units. If the trabeculæ could be proved to be true units, then any change, especially as to number, on the essential plan would have to be considered as generic.

The one difference which has perplexed me most, but which I now think admits of a simple explanation, is illustrated by Diagram C, where there is seen, in addition to the typical trabecula (*w*) shown in fig. 2, A, an extra wall trabecula (*w r*) apparently indicating a departure from the fundamental plan. The whole appearance of this new wall, often rising higher than that marked *w* in Diagram A, suggests its belonging strictly to the theca as seen from within, and, if so, it seems to indicate a special group of *Porites*, with three trabeculæ in the dividing wall instead of one. Fortunately, there is a simpler, and, as far as I can see, a completely satisfactory explanation. It is reached by reference to an ideal parent calicle (fig. 2, D), with the costal edges (*c*) of the septa sloping down to the edge of the epithecal saucer (*ep*). Each "costa" is only the outer edge of a perforated septum, and is itself perforated, and thus also built up of trabeculæ with radial and synapticular junctions. It is obvious that whether any of these costal trabeculæ develop or not depends upon the degree of crowding of the calicles. When the calicles are quite compact, and the sides are flattened against one another, we have the perimeter of the calicle a *straight*-sided polygon, the wall trabeculæ of adjacent calicles (*w* in Diagram A) alternating with one another in straight rows, the trabeculæ themselves sometimes even being flattened tangentially. A slightly less crowded arrangement is met with when the alternating trabeculæ of adjacent calicles are arranged in a zigzag, as shown in Diagram B. The zigzag is steep or shallow according to the width it has to bridge over.* When still greater intervals occur between the calicles, the costal trabeculæ come into play. They appear first in the angles between circular calicles, and then, as the width between the sides of adjacent calicles increases, they may appear in straight rows, and even in more than one row, producing the condition which we have here called cœnenchymatous. These extra rows of trabeculæ are so much intervening costal tissue between the individuals of a colony.

One of the distinctions between the Madreporidæ (excluding *Montipora*) and the Poritidæ is that, whereas *the thecæ in the Madreporidæ typically rise as cups above the level of the intervening tissue*, excepting when, as in valleys or round the bases of stocks, they are submerged by secondary growth of the latter, *in the Poritidæ no case is known of this occurring.* The intervening costal tissue is always either flush with the thecæ, or, indeed, not seldom rises above their apertures. Among the Madreporidæ, this latter condition is found in *Montipora* alone.

* This zigzag wall has been figured by Miss Ogilvie (Phil. Trans., 1896, p. 219, fig. 64 *a b*), but not quite correctly, nor was the true septal formula recognised at that time.

We believe this to be a satisfactory explanation of the extra wall trabecula (*wr*), shown in Diagram C. The intervening row of costal trabeculæ here rise above the calicle apertures and form ridges, and thus reduce the tip of the ordinary wall trabecula (*w*) till it has the appearance of being an extra granule on the septal edge. This extra granule I call the wall granule. Pl. II. fig. 7, gives an instance of *Porites* calicles with a row of intervening trabeculæ flush with the surface, while Pl. V. fig. 8, shows such a row raised into a ridge as a false wall.

As a rule the upheavals of this intervening costal tissue are most marked when the more or less rigid rectangular skeleton we have figured is melted down into a fluent network, which surges up as such into rounded knobs and ridges with a more or less woolly surface texture (see Pl. IX. fig. 5). The surface texture of forms with the rectangular skeletal reticulum is always granular, the granules representing the tips of the trabeculæ.

This preliminary sketch of the morphology of the skeleton of *Porites* enables us now to pass in review a few of its variations which in the following systematic survey have attracted most attention. But in doing so, I should like to say that, inasmuch as this sketch is one of the results of a critical analysis of the finished descriptions, which have already gone to press, it is possible that they may be so far incomplete in that characters the real signification of which have only come to light during this critical analysis may not have been detected, and it is now too late to undertake another *seriatim* study of the specimens.

The Theca.—In the description given of the thecal skeleton of the related *Goniopora* it was stated that the wall was either simple or compound; that is, it consisted of either one or more rings of trabeculæ; but it was suggested that the compound wall arose from the increase in the number of synapticulæ, between the septa, forming extra concentric rings round the fossa. There is no doubt that this happens, for as we shall see it happens in *Porites*, but the chief reason for the thick walls is undoubtedly that here given for *Porites*; if the calicles are not very crowded, intervening tissue appears, though in *Goniopora* without any attempt of this cœnenchyma to surge up as it does at times in *Porites* * (cf. also *Montipora*). In *Porites* we certainly find both methods of wall thickening—by the intervention of tissue between the calicles, and by the appearance of a condition which Mr. Gardiner has called "Trimurate." The wall is really simple, but the incipient synapticulæ, seen starting from the sides of the septal granules, may become complete and form an inner synapticular wall. When these inner rings appear on each side of the true wall (*w*) the wall appears to be 3 rings thick (cf. Pl. VI. fig. 1, and Pl. VIII. fig. 7). These two methods of developing reticular walls, each in its simplest condition consisting of three rows of trabeculæ, are quite distinct, and may be used as valuable characters. This point was unfortunately not clearly understood when the systematic portion of this volume was written.

Most *Porites* show considerable variations in different parts of one and the same colony: thin walls are common, as a rule, at the rapidly growing surfaces, while down the slopes and

* No indication of this upsurging was noted in Vol. IV., but I suspect a further and closer study might show traces of it.

round the bases of stems reticular walls frequently appear. It is not always easy to make out what method of thickening has produced the effect. Round the bases of thickening stems, where no new buds are being formed, one would expect the presence of intervening tissue.

The real structure of the wall can, however, as a rule be made out with comparative ease when the texture of a reticulum retains its simple rectangular trabecular structure. But the problem is rendered very difficult by the tendency of this texture to change into an irregular reticulum: even then one can generally recognise the trimurate condition however fluent the wall network may be, for the vertical wall pores which correspond with, and indeed are parts of the interseptal loculi, can generally be made out.

Thickenings of the wall by intervening tissue may appear in endless variety. The most interesting is that already mentioned (see above, p. 14 and fig. 2, C). A not uncommon case of this is where from such a median ridge of intervening tissue the depression of the calicle slopes straight inwards, funnel-shaped, the septa appearing wedge-shaped, diminishing inwards to fine points and without pali (cf. Pl. IX. fig. 4).

A second interesting specialisation of the wall is due to the septa being rather more lamellate than usual, with a rather slighter development of wall synapticulæ. In this case we find the top edges of the septa appearing as striæ across the wall. This is not common. Pl. VII. fig. 3 shows a patch in which the walls have become altered so as to take on this character. Fig. 5, on the same Plate, also shows the same tendency, though not so pronounced.

Profound alterations occur in the character of the whole theca, and, indeed, of the whole skeleton and of the surfaces of the stock, when the relative proportions of the structural elements are altered. The following are some of the more important variations:—

1. The loss of the rigid rectangular arrangement of trabeculæ and horizontal junctions. This results in various degrees of "fluency."

2. The development of trabeculæ as rods at the expense of the horizontal elements, which seem to reach an extreme in the specimen shown in Pl. XIV. fig. 5.

3. The development of the trabeculæ as lamellæ at the expense of the horizontal elements. The most striking example of this is seen in the axes of branching or of columnar forms. In these the central parts rise as a sheaf of lamellæ, which bend outwards all round as rod-like trabeculæ. The calicles, opening at the tip, show plainly the lamellate texture of their skeletal elements (cf. for instance, figs. 5*a* and 5*b* in Pl. XXVIII.; the former showing a more lamellate, the latter a more trabecular character of skeleton).

4. The development of the horizontal elements as lamellæ or flakes, with varying degrees of degeneration of the trabeculæ. The extreme of this is met with in *P. China Sea 4*, in which no continuous trabeculæ seem to be developed at all, and the skeleton hangs together by the irregular fusions of the wavy flakes with short trabecular rods (Pl. XXVI. fig. 2). Many branching forms develop thick, flaky, horizontal elements. (See Pl. II. fig. 8, and Pl. XXV. fig. 5.) Other specialisations might be mentioned. The elements may seem to be drawn out into long thin filaments, or, on the contrary, may be very thick and short; or one may be thin and the other thick. (Cf. for instance, Pl. VIII. fig. 3, Pl. XIV. fig. 7.) While in Pl. II. fig. 1

the horizontal elements are thin and long, in Pl. XVIII. fig. 9 they are thin and short, the trabeculæ in both being well developed.

These are only a few samples of the possible variations in the character of the skeleton due to variations in the different developments of the skeletal elements.*

The Septa.—The typical formula, with some of its variations, is seen in fig. 3, B to H, although these show only the rough ground plan of their different fusions and pali formations, and, except in E, leaving out all indications of the septal granules.

We may, perhaps, say that the septa always fuse, but that the fusions which usually take place visibly, that is, high up in the aperture of the calicle, may also occur so deep down as to be lost to sight in the columellar tangle. There is one consideration of weight which inclines me to this view, as against the suggestion that the condition in which none of the septa fuse (fig. 3, A) is primitive. If this were really primitive, the distinction between primary and secondary cycles would be more clearly seen : the primaries would project further towards the centre than the secondaries. This distinction of the cycles, shown in the diagram, is, however, not, or only very slightly, seen, and there is a reason why it should not be if the septa are in reality sloping steeply downwards, so that their inner or axial edges are involved in the columellar tangle deep down in the base of the fossa.

Further evidence for this secondary origin of the condition in which all the septa appear to be free, is seen in the fact that irregularities in the fusions always appear as the calicles deepen—that is, as the septa remain more and more incomplete round the aperture, and only project deep down. This is, however, a point to which further attention will have to be paid. We shall return to it again below in connection with the pali, and in the Introduction to the West Indian Group (Part II.).

The most persistent fusions take place between the lateral septa, and are marked by two large pali on each side of the directive plane. The dorsal directive is always free, while the ventral triplet of septa may either fuse (C, F) or its components remain separate, as shown in the diagram (B, D, E, G, H).

One other condition of the septa may be noted. When they are long and wedge-shaped, and slope inwards to a fine point with little or no development of pali, these long septa have mostly very granular edges; the granules, including the wall granule, are then frequently square, and diminish in size from the wall ridge down to the minute point-like granule, or small palus, bordering the edge of the central fossa—see, for instance, Pl. VI. fig. 6, while another case of inward sloping with diminution of the pali is seen in Pl. I. fig. 8.

The Pali.—These have been already referred to in the last paragraph in connection with the septa. They arise usually where the septa fuse, though not wholly because of the fusion,

* Both Dana (Zooph., pl. liii. figs. 7–12) and Mr. Stanley Gardiner (Proc. Zool. Soc., pl. xxiv. figs. *a*–*n*) have called attention to the different forms and heights of the wall—the former in merely the briefest outlines, the latter with more detail. But in neither case was the analysis of the fundamental structure far enough advanced at the time to admit of the differences pointed out being of practical use in the face of so many bewildering variations.

but because at those points there are, or may be, trabecular thickenings of the tissue. The Diagrams B to H, fig. 3, which give some of the patterns assumed by the palic ring, show cases of single septa developing pali, while, again, other cases are seen (F, G, H) showing septa developing no pali. The difference in these cases seems to be due to the fact that these septa

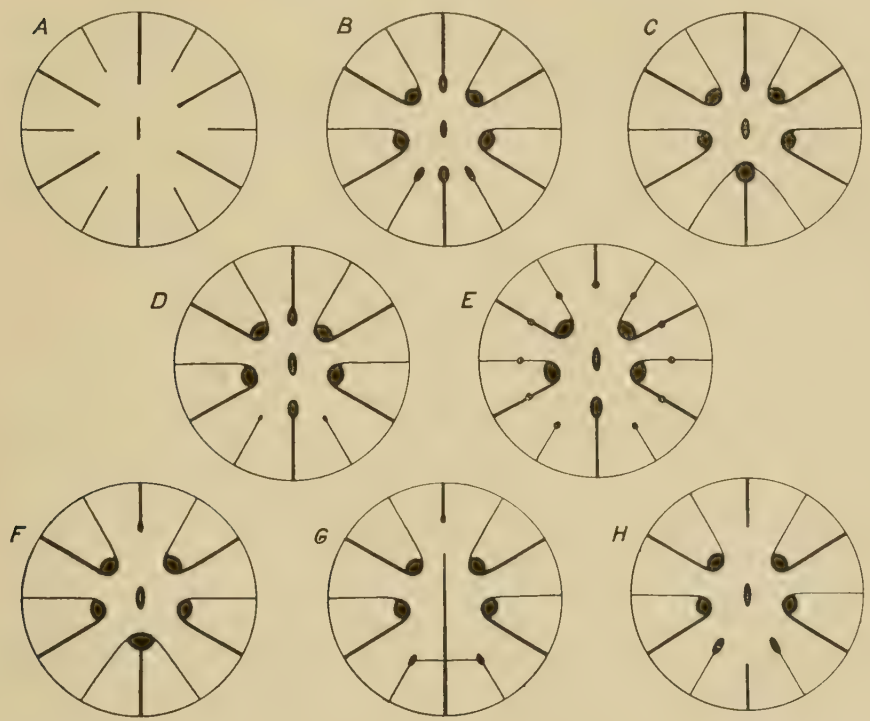

FIG. 3.— Diagrams to illustrate some of the palic formulæ referred to in the descriptions of the forms. A is an ideal calicle, showing twelve septa, with primary and secondary cycles. This (see text, pp. 18, 20) is, however, probably never seen in *Porites*, the appearances suggesting it being secondary, and due to the fact that the intra-calicular trabeculæ do not grow as fast as the wall trabeculæ, and the calicle is consequently deep. In E septal granules are indicated to show how it is possible for them to take part in the formation of the palic ring, which they sometimes seem to do. In G we see the trident formation mentioned here and there in the descriptions, the ventral directive being joined by a radial strand to the central tubercle and to the two lateral septal granules by synapticulæ.

do not yet project far enough, the trabeculæ of their inner edges having lagged behind and not risen to the surface, while in B, C, D the inner trabeculæ of the same septa rise up as pali to

the level of the rest of the ring. Other cases in which pali are not developed are when the trabecular elements are greatly degenerated either in favour of the horizontal elements, or when they have melted down into a streaming lamellate reticulum; for the rod-like character of the trabeculæ, on which the formation of the pali depends, is then lost.

Lastly, we may again refer to the loss of all the pali so commonly seen in deep calicles, and to the correlation which seems to exist between the development of the pali and the depth of the calicle; the deeper the calicle, the less developed the pali; and the shallower the calicle, the more developed the pali. This distinction has already been referred to as having had much to do with the founding of the genera *Synaræa*, p. 9, and *Neoporites*, p. 10. The fact, however, just pointed out, that the appearance of pali is mainly a question of the development of rod-like trabeculæ in height, shows that this difference is due to a growth variation of certain parts of the skeleton, without any fundamental change of plan. For instance, when the trabecular elements are undeveloped, as compared with the horizontal elements (see Pl. XXVI. figs. 1, 2), or, again, when the trabeculæ are long, thin, twisted lamellæ, there may be but very slight traces of pali. Hence their absence from so many deep calicles may be simply explained by regarding the calicle as deep because the vertical elements lag behind, and the trabeculæ of the septal granules and the pali have not developed as high as the wall trabeculæ. This tends to confirm our argument that the circle of short, free septa, shown in A, fig. 3, is not an original condition, for if we take A, B, fig. 2, and imagine the septal trabeculæ representing granules and pali left out, we should get a deep, open pit with vertical rows of spikes projecting from the walls, and representing the radial junctions which would have joined the wall trabeculæ with the septal trabeculæ had the latter been developed.

When the septa tend to be lamellate, the pali may have the V-shape which has been noted as occasionally occurring in *Goniopora*.

This explanation of the case throws light upon another rather puzzling phenomenon. Not seldom it may be noticed that septal granules seem to take part in the formation of the palic ring; this may, apparently, be the case with either of the directive septa, or with the two ventral secondaries. We now see that this would be accounted for if any of these septa were very short, and stopped at the trabeculæ of the septal granules. This relationship between the palic formula and the ring of septal granules is only indicated on Diagram E, although it probably holds in many other cases where the formula is complete (see e.g. *P. Ellice Islands 9*). The two small pali on the ventral secondaries probably frequently belong to the ring of septal granules.

This is one of the cases above hinted at, in which the results of this final analysis carry our insight somewhat deeper into the morphology than was the case when the systematic descriptions were written. The diagrams were drawn from the specimens before any correlation between the pali and the septal granules had been detected.

The Columellar Tangle.—This structure obviously depends upon the appearance of concentric synapticulæ in the central region of the calicle. A glance at B, fig. 2, shows synapticulæ starting or fully developed between the septal granules (or trabeculæ) and between

the pali (palic trabeculæ). Its presence at all depends upon these last named synapticulæ, and its size depends upon the size of the fossa in the first instance, and further upon the number of the synapticulæ joining the septal granules. We have seen cases above in which the completed synapticulæ of the septal granules thicken the wall; but other cases occur in which they increase the size of the columellar tangle (see *P. Timor Laut. 1*). It is easily seen to which part of the calicle such septal synapticulæ belong, because the larger portions of the interseptal loculi run down either inside of them or outside. In the former case they belong to the wall, in the latter to the columellar tangle.

Other elements of the columellar tangle are (1) the horizontal bars which join the central trabecula with the palic trabeculæ, or to the palic synapticulæ—these may be arranged nearly symmetrically like the spokes of a wheel—and (2) the central trabecula itself, the tip of which appears as the columellar tubercle. When this appears flattened in the directive plane, its appearance is probably only partially due to real flattening, but partly, also, to the presence of directive junctions between it and the septa in the same plane. In G, fig. 3, it is seen continuous with the ventral directive septum, forming together with two palic synapticulæ a trident.

The Fossa.—This, excepting in the deep calicles, is almost filled up with the columellar tangle and with the central tubercle, which rises to about the height of the septa. Cases of dimorphism, however, occur, in which in certain calicles the fossæ remain very deep and open. Whether these open fossæ are persistent, or only remain so temporarily while their polyps are ripening their sexual products, is not known. In a few cases, in which the fossæ are filled up by the columellar tangle and tubercle, one or more interseptal loculi may be greatly enlarged as if to take the place of the open fossa.

Tabulæ.—These are usually, if not invariably, discoverable in *Porites*, as we should expect them to be. Compare what was said under this heading in Vol. IV. p. 22. They are extremely delicate, and might easily escape notice.

Growth-forms.—All the forms produced by the stocks of this genus may again be assumed, as in *Goniopora*, to start from small astræiform colonies. (On the use of this term astræiform, and its applicability to the Poritidæ, see Vol. IV. p. 23.) The later specialisations of this colony, so as to form larger solid and branching masses, do not differ in any important point from those regulating the growth-forms of *Goniopora*. The chief difference to be pointed out is that in *Porites* the plasticity seems to be much greater. This may perhaps be accounted for by the much smaller size of the calicles.

One remarkable variation in the texture of branching forms has to be specially noted. In the one set the trabecular elements are greatly developed, and their tips cover the surface with a mosaic of granules. But there is another and very different set, in which the horizontal elements are most strongly developed, and the surface is thus flaky, though without this difference appearing in the growth-forms produced—at least, I have not noticed any way of discovering from the shape alone the nature of the texture. It is quite reasonable to suppose that in these branching forms the strengthening of the horizontal elements would be highly

advantageous. The cross sections, in that case, show a system of stout concentric rings of tissue, thus yielding a stronger support than a stem of radiating trabeculæ could possibly supply.

The remarkable growth method, described in Vol. IV. as the "expanding sheaf" form, occurs in this genus also, but it does not form columns so frequently as in *Goniopora* (compare *P. Great Barrier Reef 25* with figs. 6, 7 on Pl. XVI., which show its top and side calicles). An exaggeration of this principle of growth may perhaps be seen in the remarkable expanding table-top forms (cf. Pl. XIII. fig. 8) found in the Fiji and Ellice Islands (see, e.g. *P. Ellice Islands 5*). On the other hand, it is always possible to regard this latter growth-form as purely accidental, and due to the coral approaching too near the surface of the water, which would tend to encourage lateral rather than vertical growth.

Only two other points need be mentioned. In all the growth-forms an epitheca supports the edge of the coral up to its furthest margin. This fact, as already pointed out, has some morphological significance, and differentiates the Poritidæ from the Madreporidæ, in which the septal skeleton in explanate forms may grow out some distance beyond the epitheca. We have already called attention to this relatively superior importance of the epitheca, as indicating the rudimentary character of the Poritid skeleton.

The old controversy as to which are the older and which the younger calicles in *Goniopora*, might just as well have been applied to *Porites*. Its solution is the same in both cases (see Vol. IV., pp. 11, 12, 27).

V. THE LIVING POLYP.

Figures of the polyps of *Porites* have been given by Lesueur,* Dana,† Duchassaing and Michellotti,‡ Agassiz,§ Mr. Saville-Kent,‖ and Dr. Duerden.¶

Dana shows a retracted polyp, but was, I believe, the first to point out that the polyps when protruded differed from those of most other Madreporaria in standing high up above their calicles like stalked flowers, their skeletons being mere basal secretions.

The stinging cells first described and figured by Agassiz (l. c.) are arranged in hemispherical batteries at the tips and down the sides of the tentacles, while very large cells, 40 μ in length, containing a thick coiled thread, occur in the endoderm. These are also thought to be stinging cells; probably, while the small kind are aggressive, the large are purely defensive, and only released when the colony is injuriously attacked.

* Mem. der Museum, vi. (1820), pls. 16, 17.
† Zooph. (1848), pl. liv. figs. 5 *a* and *b* (polyp retracted).
‡ Mem. sur les Cor. des Antilles Suppl. (1864), pl. viii. fig. 2.
§ "Florida Reefs" (1880), pl. xvi.
‖ Great Barrier Reef (1893), chromoplate viii. figs. 7, 8, 9.
¶ Mem. Nat. Acad. Sci., viii. (1902) p. 415.

The polyps secrete a great deal of slime (*cf.* Duerden, l. c. p. 415), one function of which, as I have been informed by Mr. Thurston, is to protect colonies from sun and air when exposed by the tide. It is secreted in large quantities, and may hang down in streamers from specimens picked up from the reef.

The colouring, so far as the Great Barrier Reef specimens are concerned, is not very brilliant, according to Mr. Saville-Kent. Light ochres, dark and golden or mustard yellows, and browns, are the prevailing colours among the branching forms, while massive forms are often a delicate pink, light or bright lilac, more rarely a pale yellow. The oval disc and bases of the tentacles are usually the same colour as the corallum, but the tips are greenish grey. Duerden, on the other hand, speaks of the rich yellows, greens and blues of the *Porites* of the West Indies. The colouring is said to be due to three sources: (1) regular pigment cells; (2) zooxanthellæ in the tissue of the polyps; and (3) algæ which bore into the skeleton. The prevailing yellow-brown is due to the presence of the yellow pigment-cells and the zooxanthellæ. The colours given to the skeleton by the boring algæ were found by Duerden to be bright green or pink, due, apparently, to the colours of the algæ, green or red. The dried skeletons become gradually bleached.

Dr. Duerden discovered that coloration depends upon the light; under sides or shaded stocks being nearly always devoid of colour.

Mr. Saville-Kent figured the tentacles with large swollen knobs at their tips; this power of swelling the tips of the ordinary digitiform tentacles is probably general. Duerden shows a case (l. c. fig. 32*a*) with much smaller swellings.

The digitiform tentacles are frequently uniform in size, but sometimes a bilateral symmetry is visible, in that the two tentacles in the longer oral axis are the largest, while those next them on each side are the smallest. This, found also in *Madrepora*, is said by Dr. Duerden (l. c. p. 427) to be a retention of a larval condition in the development of the tentacles of certain Actiniaria, and is associated with a primitive condition of the internal mesenteries.

The primitive character of the Madreporarian polyp is shown in the fact that there is no siphonoglyph. In *Porites* the deep longitudinal folds, which necessarily arise on the contraction of the stomodæal walls, form, according to Duerden, symmetrical figures.

Mesenterial filaments are feebly developed, being confined to two or three of the pairs of mesenteries (see Duerden, l. c. p. 475).

V. THE AFFINITIES OF THE GENUS.

These were discussed and arranged in tabular form in Vol. IV. p. 29. The scheme has here been amplified and amended.

A primitive porous Coral, that is, one with a parent form in which the epithecal cup, or the prototheca, is flattened out, and the secondary theca is built of septa joined by synapticulæ.

With many cycles of septa and usually large calicles; with rapid growth in height of the secondary perforated theca, resulting in simple, or simply branching forms.	Usually with two cycles of septa, with small calicles, and with rapid growth in height of the secondary theca, resulting frequently in luxuriantly branching forms.	Septa very perforate, in two to three cycles; the secondary theca shows no rapid growth in height, but remains basal and disc-like; hence the colonies are astræiform.
THE EUPSAMMIIDÆ.	**THE MADREPORIDÆ.**	**THE PORITIDÆ.**
		With three cycles of septa, GONIOPORA.
		By suppression of one cycle, PORITES.

In the final column I have left *Goniopora* arranged as if it were the ancestral form to *Porites*. I do not mean, thereby, that it necessarily was so. From a purely ideal morphological point of view, it might have been, but, so far as actual knowledge of facts can carry us, we might just as well have arranged *Goniopora* and *Porites* side by side, the former with three and the latter with two cycles of septa, both as derivatives of some primitive Poritid. I have shown, in fig. 1, Diagram B, how the tertiary septal formula of *Goniopora* might have been reduced so as to give rise to the formula of *Porites*. But we have already emphasised the fact that whenever the septal formula of *Goniopora* suffers reduction in life, it is always very irregularly. In *Porites* the formula is so regular that we can hardly believe that it was due to any such irregular method of reduction; we have rather to believe that *Porites* never possessed the third cycle at all, and therefore, if it is derived from *Goniopora*, it is by the fixation by early maturity of a young stage, when only two cycles were developed.

VI. THE DIAGNOSIS OF THE GENUS.

Porites consists of minute Poritidæ, with twelve septal plates rising above a flattened epitheca; two of these are directives, which, with a columellar tubercle, divide the calicle bi-symmetrically. These radial plates are joined by a varying number of synapticular bars, and are themselves typically extensively perforated, and acquire all the appearance of being lattice-work, sometimes so regular as to appear as if built up of vertical and horizontal bars. The tops

of these vertical bars usually stand up above the surface as granules. In addition to the central tubercle, usually two granules appear on each septum, and one on the wall, and perhaps others between the wall granules of adjoining calicles. Two pairs of adjacent septa always fuse on each side of the directive plane, and the surface granules at their fusions form four usually conspicuous pali. Granules rising from other septa may join the ring of which these four pali are the principal members.

VII. DISTRIBUTION IN TIME AND SPACE OF THE INDO-PACIFIC FORMS.

The Table II. of the analytical section, shows at a glance the distribution, not of the forms of *Porites*, but of those forms alone which I have been able to examine. This distribution, then, is quite untrustworthy as representing the real facts. Certain regions have been examined and collections made therefrom; other regions wait. I have, for instance, seen no specimen at all from the Mergui Archipelago, yet *Porites* is said to be very abundant there; from the Maldives also I have been able to study but a very few specimens, although since the text was written I have seen a large collection from that locality made by Mr. Stanley Gardiner.

It is probable that *Porites* occurs on every reef: it may be, indeed, that it is an almost essential element, in that its density, noted above, makes it an important factor in strengthening the outer edges of the reef against the surf. Be this as it may, it is very widely distributed through tropical seas, and the forms here recorded are but a handful of samples rather than a truly representative collection.

I have extended the Indo-Pacific area in the South-west to the Cape of Good Hope, where a form occurs, probably on the shores of False Bay, in which the water is several degrees warmer than it is in the Atlantic.

The fossil forms of these Indo-Pacific regions are an almost unworked field. We shall find them slightly better represented in the Mediterranean and West Indian areas, probably not because they are more abundant, but simply because those regions have received more attention from specialists in fossil corals.

VIII. ON THE METHOD HERE ADOPTED OF PRESENTING THE FACTS.

This volume is written on exactly the same lines as Vol. IV. It is an attempt to present the facts by word and figure, without any assumption of knowledge which we do not possess. No published objections have come to my notice which might have called for reply or comment.

One apparent deficiency has, however, been pointed out to me verbally. It has been suggested that, for fossil forms, an extra term is needed to designate the horizon. With regard to this, I would point out that the geographical designation is not a description, but only a formula of reference. The addition of the horizon will only become necessary in certain

cases of very close work, when, the locality being fixed, the differences in chronological order of appearance are the simplest and most certain of the differentiating facts, those which lend themselves best to the purpose required. Whether any designation according to horizons will ever be required or not, time only can show. The principle on which the method is based, viz. the adoption of *position* on the earth's surface as a factor in the designation of specimens, will doubtless admit of very varied application. No hard-and-fast rule is proposed or even necessary, for if the method of application in each case is made clear, the synonymy ought to be easy to work out. Actual trial, however, can be the only test.

Beyond this comment, I have merely to record the results of my further experience of the method after applying it to a large, complicated genus like *Porites*.

It is obvious, with such a genus as *Porites*, with its endless minute variations, that the old method of grouping into "species" would come in most conveniently, but at the cost of all scientific worth.* To sort the specimens into groups of tens or twenties, to which a name is given, is easy so long as one is satisfied that one possesses insight into genetic relationship in the absence of all evidence. I am aware that resemblance is often said to be evidence enough for the establishment of groups which may be called "species," so long as we do not strain the genetic connotation of the word "species," and that works so written will always have a classificatory value. But this is openly and avowedly to throw away the modern ideal of a natural classification, and is hardly justifiable in an age dominated by the doctrine of evolution. It is surely more scientific to hold by this ideal, however uphill the task involved, than to attempt short cuts. But this assumed genetic value of resemblance is not justifiable in dealing with the more plastic forms of life. In highly specialised groups with complicated organs, resemblance is, undoubtedly, in the majority of cases, justification for assuming genetic affinity. The chief pitfall to be avoided is that due to what is usually known as "convergence." But with very plastic forms, without any very specialised and complicated organ formation, the case is different. In the first place, the resemblances and differences are subtle and difficult to define; to the entirely untrained eye the specimens are alike, and only as our analysis grows more and more profound do we begin to see the real characters of the differences. Here, then, is at once an argument against any attempt to group until we feel confident that we have a real insight into the structural principles discoverable in the group. But, further, it is just in the case of the plastic forms that convergence is most frequently found. They seem to be more easily moulded to the environment, so that genetically related forms, dispersed into slightly different conditions, quickly become different, and genetically different forms, cast into the same environment, quickly become alike (Vol. IV. p. 188).

* This conclusion has been still further forced upon me. It was during my preliminary efforts to arrange this difficult genus that the impossibility of applying to it the usual system first brought me to a stand in this matter. With small genera it seemed possible to effect a compromise. But not so here. Many remarks will be found scattered up and down the Volume to show into what pitfalls coral workers have been led by attempting to establish and to identify species on the old method (see, e.g., the discussion of the Red Sea "species" of Milne-Edwards).

It is obvious, then, that the task of establishing genetic species is practically hopeless in such a group as *Porites*. That method is, consequently, out of the question. The grouping according to resemblance is very hazardous, for the next analysis of structure will probably show that our groups will not stand. The only safe method is to drop all premature attempts at grouping either into genetic species or into morphological "species," and to be content with doing the preparatory work necessary before either of these former methods can be attempted with any profit.

This, then, is what I have striven to do, and the following is the chief result of the experience gained. The classification of *Porites* is an impossible task for any single person, or even any single institution. The National Collection is already large; it has been gathered, one here and one there, from some thirty-six districts. But there were certainly many other forms not represented in the collection living in each of these thirty-six districts, and hundreds of localities from which we have no specimens at all. The forms of *Porites* are indeed like the stars in the heavens, which no man can count, but perhaps even harder to deal with than the stars, for they vary, not only in position and magnitude, but also in shape and texture. It is this latter factor which makes it so difficult to catalogue them. It may be possible later, when the principles of structure are more thoroughly known, to express their differences in notes and symbols. But now, and until that can be done, it is, I repeat, clearly out of the power of any individual man or institution, to attempt a comprehensive descriptive catalogue. This volume alone, with its two parts, is witness enough that a large collection of specimens of any one genus may easily transgress the limits of practicability in the matter of hard work and expense.*

Two questions thus arise: firstly, is it worth the trouble to try to obtain any systematic knowledge at all of the Corals? and secondly, if it is, how should the difficulty be attacked?

The answer to the first question will differ in different minds. Those dominated solely by the commercial spirit will see no use whatever in attempting it; but all whose minds are unwarped and have retained their natural bent, will recognise that the pursuit of knowledge as such is not a question of utility, but of instinct. The mind has its hungers as certainly as the body, and the satisfaction of these is playing a part in human evolution, neither the end nor even the direction of which can be foreseen.

The answer to the second question seems to me to be that the localities must be dealt with separately, and, as far as possible, on the spot. Not only would each investigator discover instructive series, but he would obtain insight into the influences of the environment. It is our total ignorance of these indispensable factors in the production of the results that makes our present attempt at systematic grouping so barren a task.

* So far as my knowledge of the collection goes, there is no other genus remaining to be catalogued which shows such a wealth both of specimens and of variations on the generic type as this. There may be collections with greater numbers of specimens, but none with such a wealth of subtle variations as are seen in the intricate network-skeleton of *Porites*.

GEOGRAPHICAL ARRANGEMENT OF THE INDO-PACIFIC FORMS.

Group I.—POLYNESIA.

SOCIETY ISLANDS.

1. **Porites Society Islands** (3)**1.** (*P. Sociorum prima.*) (Pl. I. figs. 1, 2; Pl. XIII. fig. 1.)

[Tahiti,* coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites arenosa* (*partim*) Quelch (*non* Esper), Chall. Rep. xvi. (1886) p. 183.

Description.—The specimens of this coral encrusted a foliate *Mycedium* by closely enveloping its vertical edges. They adhered as swollen rounded knobs, which tended to rise and divide into flat-topped lobes. Their lower encrusting edges were nowhere free.

The calicles are 1 mm. in diameter. The walls show three variations: (1) on the top, where growth is rapid, as a light, open, foaming reticulum, somewhat flaky, but with very large irregular pores, some of which seem to run deep into the corallum (fig. 1); (2) on the sides and basal parts, the walls are solid looking, their flakes being more pronounced and flattened down, with smaller pores, but often showing the same penetration into the corallum (fig. 2); (3) in valleys between the lobes, where the calicles are smaller; and wherever they are crowded together the walls are thin, and seem to form membranous or flat trabecular ridges, often arranged in a zigzag (see fig. 1 in the left-hand lower corner). The individual trabeculæ end as frosted knobs. The flat, thick wall (No. 2) sometimes has a very conspicuous ring of large frosted granules; where the wall is quite smooth it is possible that the specimen has been rubbed, and the frosted granules broken off. The septa are very perforate, and consequently irregular along their upper edges; the typical formula is everywhere seen. There are five, six, or eight pali, forming the three most usual symmetrical patterns (see Introduction, p. 19, fig. 3, F, C, B). The pali frequently rise from a light columellar ring, and there is mostly a visible central tubercle. Both pali and tubercle end in frosted knobs, large or small, according to the position on the corallum. The interseptal loculi are round and open—except in the more solid basal parts of the corallum.

There are two very fine specimens of this *Porites*, and a fragment in spirit. The smaller

* Most probably from the Papeete reefs (see specimen *c*).

of the two shows its relation to the *Mycedium*, both fresh and corroded fragments of which adhere to the specimen. The larger, *a*, no longer shows its attachment, but it is essentially of the same shape, and small encrusting portions of a *Mycedium* are still attached to it.

Whether this *Porites* always grows in association with *Mycedium* we have no means of knowing. The growth-form of both specimens is clearly due to this fact. The calicles are very different from those of both the other known *Porites* from the Society Islands. The spirit specimen is from Papeete.

Of morphological interest are the large vertical pores running into the walls. Somewhat similar pores appear in *P. Tonga Islands 1* (see Plate I. fig. 7); but in that case they are more obviously the portions of interseptal loculi cut off by the outermost ring of synapticulæ.

a. A lobate colony, 10 cm. high, 6 × 10 across the top.	Zool. Dept. 86. 12. 9. 291.
b. A young colony, showing method of attachment to the *Mycedium*.	Zool. Dept. 86. 12. 9. 364.
c. A rounded colony, with a fragment (in spirit).	Zool. Dept. 80. 11. 25. 220 (part).

2. **Porites Society Islands** $_{(3)}$**2.** (*P. Sociorum secunda.*) (Pl. X. fig. 4.)

[Tahiti,* coll. H.M.S. 'Challenger' and Museum Godeffroy; British Museum.]

Syn. *Porites latistellata* Quelch, Chall. Rep. xvi. (1886) p. 185, pl. xi. figs. 6, 6*a*.
Napopora irregularis Quelch, Chall. Rep. xvi. (1886) p. 186, pl. viii. figs. 6, 6*a*.

Description.—The corallum rises from a small explanate base into close tufts of stems, which are often united to one another both by fusions of the stems themselves, and also by the outgrowth of free explanate edges from their sides. The stems are of different shapes, either short, angular, and flat-topped, or long, thin, flabellate, and rounded. The tufts are symmetrically round-topped and about 12 cm. high.

The calicles are about 1·2 mm. in diameter, but are very ill-defined, often mere shallow breaks in a skeletal texture composed of flat flakes which run out into frosted points. The walls are very broad, but throw up a usually sharp median ridge above the flakes. This ridge, which runs round single calicles, or sometimes encircles two or three at a time, shows every variation in texture, from flakes perforated with pores to a fine foaming filamentous reticulum, e.g. at the growing tips. When these cœnenchymatous wall-ridges are sharp and high, the whole surface of the stem is ragged and fluffy. The septa are very irregular, and are mostly tongues of the wall flakes, sometimes broad, sometimes narrow and much twisted. In the younger calicles the typical septal formula can at times be made out, but in older calicles the texture becomes more strikingly flaky, and the radial symmetry is obscured. The ring of pali is often visible to the naked eye as a boss, but under the lens the individual pali are frequently difficult to distinguish from the general tangle of the intra-calicular skeleton. The interseptal loculi vary in width, according as the septa are narrow or broad; they seldom run deep into the coral.

In section vertical trabeculæ are seldom seen, the coral being built up of a confused reticulum in which horizontal elements are sometimes conspicuous.

* The 'Challenger' specimen *c* is from the "Papeete reefs."

This *Porites* is very remarkable. A branching form, built up mainly of flat flakes, and having at the same time surging walls, is a rare variation on the ordinary texture of *Porites*. A skeleton built of flakes usually results in thin, flat, explanate coralla (see *P. China Sea 4*, also *Goniopora China Sea 3*, Vol. IV. p. 72). Smooth branching forms, built up of horizontal flakes, are not unknown (see Table III.), so it can hardly be said that it is exclusively to the foaming cœnenchymatous ridges that we owe the fact that the surface of the original thin explanate stock rises into tufts and tangles of jagged, angular stems. For the peculiarly fluffy appearance of the surface, compare the form called *Montipora friabilis*, from some unknown locality, Vol. III. p. 138.

The specific name "*latistellata*" is due to a misunderstanding. Mr. Quelch measured the calicles from ridge to ridge and found them 3 mm. across, as if the tops of the ridges were the walls. He also says the septa were from twelve to sixteen in number (see his fig. 6*a*, Pl. XI.) This latter number can only refer to the few double calicles which occur here as on most other *Porites*.

Since Mr. Quelch's description of his "species" appeared, in 1886, two large complete specimens, formerly in the Museum Godeffroy, have been acquired. These, being also from Tahiti, and showing the same essential features, serve to link together the specimens called "*Porites latistellata*" with the type specimen of the proposed genus *Napopora*. The resemblance between the two had not been overlooked by Mr. Quelch, but he would hardly have been justified, with the material at his disposal, in classing them together. (Cf. note on the genus *Napopora*, Introduction, p. 12.)

The Museum is fortunate enough to possess three complete stocks showing great variations, but all essentially of the same texture and structure.

*a**–*b*. Complete stocks, with long, rounded or flabellate stems. Originally from the Museum Godeffroy, and purchased from Mr. John Morgan.	Zool. Dept. 99. 3. 2. 10–9.
c. A small stock, with short, stunted stems, the type-specimen of Mr. Quelch's "species," "*Porites latistellata*" (in spirit).	Zool. Dept. 80. 11. 25. 218 (part).
d–*f*. Small fragments.	Zool. Dept. 86. 12. 9. 294. 349. 390.
g. Type of the genus *Napopora* (see p. 12).	Zool. Dept. 86. 12. 9. 302.

3. **Porites Society Islands** (3)**3.** (*P. Sociorum tertia.*) (Pl. I. figs. 3, 4, 5; Pl. X. fig. 5.)

[Tahiti,† coll. H.M.S. 'Challenger' and the Museum Godeffroy; British Museum and Cambridge University Museum.]

Syn. *Synaræa convexa* Verrill, Bull. Mus. Comp. Zool. i. (1864) p. 43.
Synaræa solida ibid.
Synaræa convexa Quelch, Chall. Rep. xvi. (1886) p. 187.

Description.—The corallum, starting from a small base, sends up thin, angular, flame-like processes. These increase rapidly in thickness, become crowded and fused together till they

* Specimen *a* is encrusted on one side by a portion of a *Montipora*, having somewhat the same skeletal texture as the well known Singapore form called by Dana "*Montipora hispida*."

† Specimen *f* is from the Papeete reefs.

form compact convex or even hemispherical masses. The aspect of the upper surface varies in the different specimens, owing, apparently, to the degree of crowding of the stems; the ragged branching tips of the stems may be fairly distinct, or they may be so close and fused as to form a nearly solid mass, the tips of the branchings then appearing as narrow, very irregular ridges separating smooth shallow valleys. The living colony extends 3 to 4 cm. deep.

The calicles are everywhere small, about 1 mm. across, and superficial. The broad, flat walls rise into cœnenchymatous swellings, especially near the tips of the stems; these swellings may be flat-topped, or round, or thick and conical; down the sides of the stems they diminish to narrow waves or ridges. The whole surface is covered with finely echinulate granules, which tend to conceal the smooth flat wall-flakes. The complete septal formula can be made out in the younger uppermost calicles, where the skeletal reticulum is thinner and the surface granules smaller (see Pl. I. fig. 3); here the pali form an almost complete ring round a large, deep, and very conspicuous fossa. On the lower parts of the stems the granules are larger, and cover the surface much more completely, at the same time greatly thickening the septa. A minute central tubercle then appears in the fossa.

This coral, like the last, is one of those rare *Porites* in which the wall reticulum foams up, causing the surface of the coral to rise up into angular flame-like stems. It is not a little remarkable to find two such forms (compare that last described) occurring in the same locality and differing so widely from one another (for other cœnenchymatous *Porites*, see Table IV.).

There are six typical specimens in the British Museum and one in the Cambridge Museum, and there is one other specimen, *g*, in the National Collection which is, I think, a variation. It seems possible to account for all the differences between it and the rest by assuming a slightly more rapid growth. This would cause (*a*) a greater proliferation of the cœnenchymatous upheavals, thus making the stock more irregular and ragged, and (*b*) the skeletal elements to have a more open filamentous reticulum, so that the stiffer skeleton of the typical forms, with its smooth flaky walls, and the trabeculæ, with their frosted tips, could not be developed. These are, indeed, exactly the changes we find in this single specimen (see Pl. I. fig. 5, and Pl. X. fig. 5).

Professor Verrill's distinctions between the forms he called "*convexa*" and "*solida*" are, I believe, also mainly accidental. He describes *S. convexa* as of a dark ash colour, and *S. solida* as greyish brown. Only one of the British Museum specimens is unbleached; it is brown at the tips, with a tinge of olive-green appearing at the sides. I should find it difficult to decide whether it is *convexa* or *solida*.

In fig. 3 the flat wall flakes are clearly visible between the surface granules. In fig. 4 from the lower parts of a stem, the granules are so large as to conceal the wall altogether.

The specific name *convexa* was given by Professor Studer to a *Porites* from New Guinea (see *P. New Guinea 1*).

a, *b*, *c*. Complete stocks from the Museum Godeffroy. — Zool. Dept. 99. 3. 2. 12–13.

d, *e*, *f*. Portions of stocks—*f* is in spirit —from the 'Challenger' Collection. Figs. 3 and 4 are of *d*. — Zool. Dept. 86. 12. 9. 309–354. 80. 11. 25. 236.

g. The specimen figured 5 on Pl. I. and 5 on Pl. X. from the Museum Godeffroy. — Zool. Dept. 99. 3. 2. 11.

UNION ISLANDS.

4. **Porites Union Islands** (1). (*P. Tokelauensis prima.*)

[Duke of York Island; Hamburg Museum.]

Syn. *Porites cylindrica* Rehberg (? Dana), Abh. Naturwiss. Ver. Hamburg, xii. (1892) p. 47.

Dr. Rehberg merely recorded the existence of a perfectly preserved branching *Porites* in the Hamburg Museum from this locality. He compared it with both Dana's "*cylindrica*" (? Fiji Islands) and with Brüggemann's "*decipiens*" from Ponapé. It should be noticed that the latter author did not himself suggest any affinity between his coral and Dana's.

SAMOA.

5. **Porites Samoa** (1). (*P. Samoensis prima.*) (Pl. I. fig. 6; Pl. XIII. fig. 2.)

[Samoa, coll. Count Castelli; British Museum.]

Description.—The corallum is a single, complete, detached, nearly cylindrical stem 6 cm. long and 2·5 c.m. thick, with base partly encircled by an epithecal film. Small nipple-shaped processes, 1 cm. long by 0·5 cm. thick, grow out irregularly from what was the upper surface of the sloping stem, and tend to form a cluster at its tip.

The calicles are very minute, 0·5 mm., quite superficial. The details of skeletal structure are obscured by surface granules, but the walls appear to be flaky, and, as compared with the small size of the calicles, thick (0·3 mm.). The walls rise as an irregular ring of round very frosted granules. These encircle an inner ring of septal granules; within this again is a compact regular ring of slightly larger pali. From the pali we gather that the septal formula is typical, as can indeed be occasionally seen. The fossa is minute, usually deep, but here and there closed by a central tubercle below the level of the pali. The interseptal loculi, when visible, show the radial symmetry of the calicles, and sometimes run from the fossa on to the walls. There are three variations in the texture of the surface: (1) the calicles are clearly visible, because the flakes and granules are small, and show traces even of septa with deep intervening interseptal loculi; (2) the calicles are obscured owing to the prominence, large size, and consequent crowding of the frosted granules, making the whole surface an elegant mosaic, but at

the same time concealing the calicle skeleton, the fossa alone usually remaining distinct,—this condition of the surface appears on the upper side of the sloping stem; (3) the calicles are obscured by the great size and prominence of wall flakes, into which the frosted granules have developed. This condition of the surface may be a growth stage, or else a permanent characteristic of the under side of the stem.

The colour of the unbleached stock is light yellowish brown. The section shows the close axial reticulum surrounded by a dense rectangular network of stout radial trabeculæ and horizontal (concentric) elements, both about equally developed.

This, which is only a fragment of a stock, though apparently a complete stem, is the first described *Porites* from Samoa. It was obtained from Count Castelli's museum as "*Porites mucronata Dana.*" But Dana's coral called "*Porites nigrescens*" var. "*mucronata*" was from the Sooloo sea ("*P. nigrescens*" being from the Fiji Islands); its calicles were said to be 1·5 mm. across, that is nearly three times as large as those of this coral, and its branching was quite different.

For other branching forms with minute calicles, and the surface tending to consist of a mosaic of granules, see Table III., in the Analytical Section.

The photograph, Plate I. fig. 6, is taken from the side of the sloping stem near the base.

a. Zool. Dept. 98. 8. 1. 93.

Of previous records of *Porites* from Samoa without descriptions, I have found the following:—

1. A branching form compared with *P. decipiens* Brüggemann, perhaps the same as No. 5 below. Ortmann, Zool. Jahrb. (Syst.) iii. (1888) p. 157. (For Brüggemann's coral, see *P. Caroline Islands 1*).

2. A massive form compared with *P. lutea*, apparently of Klunzinger (cf. *P. Red Sea 2*). See Ortmann, l. c.

3. A massive form, with surface marked with wavy cœnenchymatous ridges, compared with *P. Red Sea 6* (= *Synaræa lutea* of Klunzinger). See Ortmann, l. c. p. 158.

4. A cœnenchymatous branching form compared with *P. Society Islands 3* ("*convexa*" Verrill), perhaps the same as No. 6 below. See Ortmann, l. c. p. 158.

5. A branching form closely resembling *P. Caroline Islands 1* (= *P. decipiens* Brüggemann), cf. No. 1. See Studer, Zool. Jahrb. (Syst.) xiv. (1901) p. 390.

6. A cœnenchymatous branching form compared with *P. contigua* Dana. This may perhaps be the same as No. 4. Studer, l. c. p. 397.

An examination of the *Porites* of Samoa would show us, therefore, at least five forms belonging to the Islands. Of these, two are apparently smooth branching forms, and one a cœnenchymatous branching form—one of the former is that here described, and as far as I can see, without any similarity whatever to the coral called "*P. decipiens*" by Brüggemann. (See *P. Caroline Islands 1.*)

TONGA ISLANDS.

6. Porites Tonga Islands (10)1. (*P. Tongaensis prima.*)

[Tongatabu, coll. Quoy and Gaimard; Paris Museum.]

Syn. *Porites conglomerata* (*partim*) Q. & G. (*non* Esper), Voyage de 'l'Astrolabe,' Zooph. iv. (1833) p. 249.
Porites lutea, M.-E. & H., Ann. Sci. Nat. xvi. (1851) p. 28.

Description.—The corallum tends to be short, columnar, with round, slightly swollen top, supported as a thick column or neck, covered with chalky epitheca. The living layer extends downwards about 2·5–3 cm.

The calicles are very small, 0·75 mm. in diameter, hardly depressed, polygonal, or subcircular. The wall is a thin, irregular, or zigzag thread, which is hardly visible to the naked eye. The septa project as frosted granules or points (not knobbed) from the margin, and are very irregular: two or three may sometimes be prominent even at the margin, but a short way below the surface they appear thick, obscure, frosted, and fusing together. There is a ring of pali sometimes complete (fig. 3, B). They are frosted, echinulate, and irregular in size. The fossa is conspicuous to the naked eye. The tubercle, usually flattened, is deep down, the interseptal loculi inconspicuous, but appearing as long thin slits in the lateral calicles.

The specimen here described is in the Paris Museum, Z. 191*a*. It appears to be the original "variety" of the *Porites conglomerata* of Quoy and Gaimard, which Milne-Edwards and Haime re-named "*P. lutea.*" The label bears the date "1829."

There are several stalked specimens from the Tonga Islands (see Nos. 4, 5, 6 in this Catalogue), but the calicles in no case seem to fit in with this description.

The other specimens labelled "*lutea*" in the Paris Museum are quite different, as are also all the many "*lutea*"*s* which are scattered through the records. This is another of those early names which has been given absolutely recklessly by nearly every writer who has "named" any *Porites*.

For the type-specimen of the "*P. conglomerata*" of Quoy and Gaimard, the original of which seems to be lost, see *P. Queen Charlotte Islands.*

7. Porites Tonga Islands (10)2. (*P. Tongaensis secunda.*) (Pl. I. fig. 7; Pl. XIII. fig. 3.)

[Tongatabu, coll. J. J. Lister; British Museum.]

Description.—The corallum is massive, the exact form being unknown; the upper surface is wavy, and rises to a blunt point. The living colony, which formed a small cap to a large dead mass, dies away progressively on all sides, without any edge formation.

The calicles are conspicuous because of the deep, open fossa; variable in size, the largest (1·5 mm.) being on the smooth, round-topped waves. The walls have a low, thick, median ridge, making a polygonal pattern over the surface, and are sometimes, especially on the waves, thickened by a complete or partial ring of synapticulæ, which make the walls look stout and reticular; the skeletal bars of this wall network are short and thick, and the pores enclosed by them round and conspicuous. The septa are also short and thick, project but a short way into the fossa, and seldom meet one another to form any part of the typical formula. Deep down in the large open fossa the columellar tangle consists of a few irregular thick strands, showing no striking characters. In the section, which is very dense, the walls are especially thick and solid, and there are immense numbers of tabulæ.

Small, funnel-shaped calicles appear in the wall-angles.

There are two fragments which fit together and show the greater part of the colony, but not the whole of the growth-form. In the wavy surface of this specimen and in its deep, stout-walled calicles, in which the septa are usually too short to meet and fuse, we have characters similar to those of the well-known West Indian form called *Astræoides* (see Part II.). The disappearance of the pali in this coral is certainly secondary (see, on this point, Introduction, p. 18).

The figure shows some of the larger calicles from one of the slopes near the top of the stock. The formation of the reticular wall out of a ring of synapticulæ is well shown in the figure.

a, *b*. Fragments which fit together. Zool. Dept. 1904. 10. 17. 1 and 2.

8. **Porites Tonga Islands (10)3.** (*P. Tongaensis tertia.*) (Pl. I. fig. 8.)

[Tongatabu, coll. J. J. Lister; British Museum.]

Description.—The corallum closely encrusts the irregular surfaces of dead corals; about 1 cm. thick in the middle, with thin creeping edges.

The calicles are conspicuous as funnel-shaped depressions, with sharp, polygonal margins and deep central fossæ. The funnels are small and steep on the highest parts of the stock, large (nearly 2 mm.) and shallow on sloping sides. The walls consist of thin, straight, median ridges, hardly raised above the surface, broken up into smooth granules, which are small and round in the deep, uppermost calicles, and elsewhere lengthened out and even running together to form a continuous thread; these are the tips of thin, flat trabeculæ. On each side of and high up on this wall-ridge the septa appear as flakes, very small in the uppermost calicles, but large in the large calicles; they are joined by thin stalks to the wall-ridge. From these flakes the septa slope into the fossa as thin, vertical laminæ, with frosted or finely echinulate sides and edges. In the shallower calicles (fig. 8) these thin septa become broad, flat tongues. The septa in the deeper calicles slope steeply down into the fossa, in the base and round the sides of which are a few scattered granules. In the shallower calicles the more conspicuous septa

slope only gradually round a much smaller fossa, with larger granules in its base. There is no regular system of pali; the septa, though approaching one another as if about to fuse, rarely actually meet.

The interseptal loculi run right up to the wall-ridge, and give the calicles a stellate appearance.

There is only one specimen of this coral. Its growth-form is not very clear, but its calicles should enable it to be identified again without difficulty.

The figure shows the largest lateral calicles. In the centre of the figure is a patch showing the skeletal elements abnormally thickened.

a. Zool. Dept. 1904. 10. 17. 3.

9. **Porites Tonga Islands** $_{(10)}$**4.** (*P. Tongaensis quarta.*) (Pl. I. fig. 9; Pl. XIII. fig. 4.)

[Tongatabu, coll. J. J. Lister; British Museum.]

Description.—The corallum forms pear-shaped knobs round the tips of branching corals; the surface is wavy, and the edges creep downwards, closely adherent.

The calicles are small, averaging 1 mm., but conspicuous and angular. The walls are very thin and membranous, consisting of flattened trabeculæ arranged in an irregular zigzag round the calicle; their upper edges may be either denticulate or straight with a few incisions. The septa, which are extremely thin, are indicated round the margin as blunt points at the angles of the zigzag; they project lower down as twelve thin plates, very perforate and interrupted and fusing irregularly, and sometimes suggesting fig. 3, E. The pali rise as small frosted or angular granules. On the tops of the waves of the surface, where the calicles are largest, the walls are thickened a short way below the ridge by a ring of synapticulæ, and at the points where they join, the septal granules may rise to form a ring round the pali. The fossa is a deep, round pinhole, with rarely any trace of skeletal tissue visible from above.

This coral is represented by only one specimen. Its method of growth and its calicles should be easily identified again.

Its affinities with the three following forms can only be made out when we have a much greater series for examination.

The young buds, which are plentiful on the uppermost surface, rise up like small, gaping membranous rings. Double calicles are numerous. The living layer extends 6 cm. and more round the stalk-like base.

The fig. 9 is from near the top of the stock; it shows also a few cases in which the walls are thickened.

Compare observations on this growth-form under *P. Tonga Islands 7*.

a. Zool. Dept. 91. 3. 6. 82.

10. **Porites Tonga Islands (10)5.** (*P. Tongaensis quinta.*) (Pl. II. fig. 1; Pl. XIII. fig. 5.)

[Tongatabu, coll. J. J. Lister; British Museum.]

Description.—The corallum, like the preceding form, is a knob which envelops the tips of branching corals; its surface is smooth, and the lower margins of the colony seem to die regularly upwards without the formation of creeping edges.

The calicles, about 1 mm. in diameter, are nearly flush with the surface. The walls are straight on the flattened top, and are either extremely thin and friable with straight or ragged edges, or thickened and reticular, owing apparently to the addition of a regular or irregular ring of synapticulæ on each side; this thickening may be confined to single sides and wall-angles. The septa in the uppermost calicles are very thin, fragile, perforate plates, slightly bent, and with jagged surfaces. They seem to be arranged most often as in fig. 3, B, but the ventral triplet shows irregular fusions. In the calicles round the lower parts of the stock, with thickened skeletal elements, the septa are also thickened, and the pali, which in the uppermost calicles are slightly frosted or branching points, are round, frosted granules.

The columellar tangle seldom forms a complete ring beneath the pali; its elements are more often arranged radially round a small central tubercle.

This coral must certainly be allied in some way both with that which precedes it and with that which follows it. Their growth-forms, and the structural types of the calicles, are so much alike that it is quite puzzling to find such diversity in detail. A comparison of the figures will show at a glance how great these differences are. The whole stock is 6 cm. high, and the living layer extends about 3 cm. down the sides.

The figure is taken from the flattened top of the stock.

Compare observations on this growth-form under *P. Tonga Islands 7.*

a. Zool. Dept. 1904. 10. 17. 4.

11. **Porites Tonga Islands (10)6.** (Pl. II. fig. 2; Pl. XIII. fig. 6.)

[Tongatabu, coll. J. J. Lister; British Museum.]

Description.—The corallum forms pear-shaped knobs, with wavy surface, but not, as in the two preceding forms, round the branches of other corals. This coral started as an encrusting colony, and rose in the centre. The colony extends but 3·5 cm. down the sides with only slight edge-formation, here overhanging, there dying upwards with formation of epithecal films.

The calicles are superficial, angular to subcircular, and slightly over 1 mm. in diameter. The wall-ridges are very thin and membranous, but irregularly bent into zigzags, and so porous that the edges are ragged and interrupted; here and there they are reticular, especially when the circular calicle is surrounded by an angular wall-ridge; then the corners of this area are

cut off by the formation of concentric synapticulæ which thicken the wall. The septa are thin and lamellate, but wavy and bent, though not so much so as to spoil the radial symmetry. The pali form complete circles conspicuous to the naked eye (cf. fig. 3, B, p. 19). The principal pali are often V-shaped plates. The central tubercle is mostly flattened in the directive plane, and is supported on radial plates which seem to be usually joined to the fused pairs of septa. All the skeletal elements gradually thicken and frost over down the sides of the stock, and the pali become very conspicuous as small compact groups rising in the centre of very shallow polygonal areas.

There is again only one specimen. Its growth-form is interesting compared with the pear-shaped growths of the preceding two forms, which differ in being attached to the tips of branches of other corals. The more important differences relate to the details of calicle structure, and in spite of the close superficial resemblances between this, the next, and the two preceding forms, can be easily seen on a close comparison of the figures and descriptions. Compare the observations under the next heading.

a. Zool. Dept. 1904. 10. 17. 5.

12. Porites Tonga Islands $_{(10)}$7. (Pl. II. figs. 3, 4.)

[Tongatabu, coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites arenosa* (*partim*) Quelch (*non* Esper *), Chall. Rep. xvi. (1886) p. 183.

Description.—The corallum is only a fragment, but is apparently a vertical segment of an erect pear-shaped stock, like those of the last three forms.

The calicles are quite flush with the surface, a little over 1 mm. in diameter, and subcircular. The walls on the top are an open reticulum without median ridge, very uneven in thickness, sometimes allowing communication between adjacent calicles, and with the skeletal elements uniformly thin and membranous, but so porous as to be almost filamentous. The septa are still thinner but slightly more lamellate, and with very ragged tops and edges; they are in a complete formula (fig. 3, B). The pali are so minute as to be invisible to the naked eye. The central tubercle, which rises from a columellar tangle without a ring, is often flattened in the directive plane. All the skeletal elements are slightly echinulate. The pali remain invisible even in the calicles near the lower edges of the stock, where all the elements are immensely thickened. The vertical section shows a regular radiating expansion of trabeculæ from the centre of the base. The outermost bend outwards and hang down all round the base.

This is the last specimen of this remarkable group, which is united by the similarity in growth-form, by the extreme delicacy of texture, and by the general type of calicle structure. But the more closely the four corals are examined, the more marked are their differences. We have no means of ascertaining what their real affinities are: we can only describe them as so many

* For *P. arenosa* see the forms from unknown localities, Part II.

variations of structure assumed by *Porites*. There is no means of deciding whether they are specifically related—their variations being due to slight differences in environment—or whether they are all distinct species beginning to resemble one another from having to adopt the same method of life. If the pear-shaped growth form is due in any way to the environment, which seems highly probable, then the similarity in the topmost calicles might be due to the tendency of the skeleton to rise in bundles of lamellæ, a method of growth described in Vol. IV., p. 26, as not uncommon in the allied genus *Goniopora*. The coral above described is the only one of the four which shows a vertical section, and it is quite typical of the "expanding-sheaf" method of growth. Other examples of this method also occur in *Porites*, see Introduction, p. 21.

Fig. 3 is from the top, and fig. 4 from the bottom. The minute pali are visible in these magnified photographs.

a. Zool. Dept. 86. 12. 9. 292.

13. **Porites Tonga Islands** (10)**8.** (Pl. II. figs. 5, 6; Pl. X. fig. 6.)

[Tongatabu, coll. J. J. Lister; British Museum.]

Syn. *Porites lævis* (non *P. levis* Dana), M.-E. & H., Ann. Sci. Nat. xvi. (1851) p. 27.

Description.—The corallum consists of dichotomously branching stems, diverging at angles of 45° and less. The tips flatten and fork into two thick, blunt processes, while the portions of the stems between the divisions are usually swollen. The living stems may be 8 cm. long, with lower edges which creep rather freely; they rise from a tangle of fused, broken and rotting stems of earlier growths, the uppermost branches of which are either still alive or are capped with new colonies.

The calicles are about 1·25 mm. in diameter, and, if slightly pitted near the tips of the stems, they are usually flush on the lower parts. The wall seems to be built of thick, flat, but rather scanty flakes, obscured by well-spaced, frosted granules, which rise upon them. The septa are conspicuous, and usually as in fig. 3, B, though with some uncertainty in the ventral triplet, which sometimes shows two, at others three, granules. These surface granules, which are the tips of the trabeculæ, are important features; there are "intervening" granules (see p. 15), wall granules, septal granules, separated from the wall granules by a sharp, circular furrow; and within the ring of septal granules is a ring of pali which, especially the principal pali, are larger than the septal granules. The columellar tubercle is large and oval, or flattened in the directive plane. All the granules are finely echinulate or frosted.

There are five specimens and a box of fragments of this *Porites*; the three largest rise from portions of the dead tangle of previous growths; the stems forming this tangle are mostly greatly corroded, and seem to have fallen over (see figures showing growth-form). The calicles in all the specimens are of the same type, but differ in the height and width of the walls. But as these may vary on the two sides of one and the same stem, they afford us no basis for further subdivision.

Specimen *a* (see Pl. X. fig. 6, the right half) shows a previous growth apparently on its side; from it the living colony has bent upwards. The calicles on the upper face of the living colony are flush with the surface; the walls are broad and flat, and the granulation is delicate and scattered; nearer the lower edge of the colony (see Pl. II. fig. 6) the granules are large enough to render the surface a smooth mosaic. On the under surface there is a median ridge along the somewhat narrower wall. It consists of a single row of frosted granules; this shows as a fine, slightly raised network over the whole lower surface.

Specimen *b* (see Pl. X. fig. 6, on the left) is like *a* in general appearance, only it grew erect, and the calicle walls rise into a ridge, which, however, is not due to the presence of a single row of granules, but to a general elevation of the surface; the calicles are, consequently, slightly pitted. They are crowded on one side of the stems, but wider apart on the other. Correlated with this raising of the walls, we find the wall and palic granules are much smaller.

Specimen *c* seems to be the surviving portion of a stock which had turned almost head downwards. Its calicles are concavely pitted over most of the upper surface of the sloping stems.

Specimens *d* and *e* are small colonies snapped off just above the dead tangle.

As pointed out in the Introduction, p. 21, branching *Porites*, except the cœnenchymatous forms *P. Society Islands 2* and *3*, which can hardly be reckoned among the true branching forms, tend to develop most strongly either the trabecular or the horizontal elements; in the former case the surface tends to be a mosaic of granules, which are the tips of radial trabeculæ. The different forms are then difficult to distinguish, or rather the differences are difficult to describe in words. The student must study the photographs, which, being nearly optical surfaces, show very little of the lower horizontal or tangential tissue uniting the trabeculæ together. These, however, are seen clearly with a pocket lens.

Fig. 6, as compared with fig. 5, shows the thicker trabeculæ of the lower part of the stem; while a comparison of figs. 6, 7 and 9 shows varying arrangements of the tips of radial trabeculæ.

It is interesting to note that, side by side with this coral, in which the radial trabeculæ are the chief factors in the formation of the skeleton, there occurs another branching *Porites*, in which the horizontal elements are most developed (see fig. 8).

There are two worn fragments of this coral in the Paris Museum (No. 190*a*), labelled as if they formed part of the original collection of Quoy and Gaimard; they were named "*P. lævis* Dana" by Milne-Edwards and Haime (Ann. Sci. Nat. (1851) p. 27). We may gather how very little these authors were at that time prepared to recognise structural differences from the fact that they thought these two forms were like the famous figure (Pl. LIX.) of Esper's *Madrepora conglomerata*, which has never yet been re-identified. Since Esper's coral had "fifteen to twenty septa," it was not a *Porites* at all, but a *Goniopora*. Its deep, funnel-shaped calicles, not to mention its very striking growth-form, ought to have distinguished it sufficiently from Dana's *levis* (= *P. Fiji Islands 1*).

Mention should be made of the fact that in the gradual bleaching of the corals by light, the organic matter within the calicles remains, causing the latter to stand out as conspicuous dark circles upon the light-grey background of the walls and intervening tissue.

a.	Zool. Dept. 91. 3. 6. 24.
b–e.	Zool. Dept. 1904. 10. 17. 6.
f. A box of fragments.	Zool. Dept. 1904. 10. 17. 10.

14. **Porites Tonga Islands** (10)**9.** (Pl. II. fig. 7; Pl. X. fig. 7.)

[Tongatabu, coll. J. J. Lister; British Museum.]

Description.—The corallum forms low dense tufts of short, thick, curving branchlets, which sometimes rise from an expanding base; the stems fuse freely together, and the colonies, as in the last case, rise from a tangle of dead and often overturned previous growths, and may thus be without firm attachment to the substratum (see the figures of growth-forms).

The calicles, as in the last form, depend upon the arrangement of the surface granules; the chief differences are due to the persistence in this form of a wall-ridge. This ridge, though very slight, is sharply raised above the otherwise smooth surface at the tips of the stems, and is traceable over the whole stock as a polygonal network. The broad flat flakes of the walls below the surface granules are so perforated as to be almost a filamentous reticulum, and consequently the granules upon them, which are destined to construct the next flake layer, are not so solid as in the last form, but more branching and feathery. On each side of the median intervening * granules is a row of large distinct wall-granules, within which is a ring of septal granules round the pali; all the granules are delicate, feathery, and well spaced. The palic formula (fig. 3, B) is regular and complete. The principal pali are large and oval. The central tubercle is flattened in the directive plane.

This coral is certainly closely related to the form last described. Its short stems flatten and divide, the two forks, as in *P. Tonga Islands 8*, being short, thick, and flat-topped. The difference in the growth-form is, perhaps, sufficient to account for the difference in the calicles, for the stems being so much shorter do not require the skeletal elements to be so stout; hence the trabeculæ seen in the transverse section are thinner, while again the thinner trabeculæ account for the better spacing of the granules. This form may then be regarded as a stunted variety of the foregoing; that it is not merely an individual variation we gather from the fact that the dead overturned stocks on which it grows are similarly stunted.

The living layer is not more than 5 cm. deep; its lower edges seem to creep rather freely. On such encrusting edges the sharp raised wall-ridges appear round the calicles. The photograph, again, shows no traces of the horizontal tissue beneath the layer of granules.

a, b. Zool. Dept. 1904. 10. 17. 11. 12.

15. **Porites Tonga Islands** (10)**10.** (Pl. II. fig. 8; Pl. XI. fig. 1.)

[Tongatabu, coll. J. J. Lister; British Museum.]

Description.—The corallum forms rather open clusters of thin, slightly tapering stems, which fork dichotomously, though somewhat irregularly. The branchlets mostly have a faint

* See Introduction, p. 15.

curve. The specimens are perhaps distorted by Balanids. The basal stems are about 1·5 cm. thick, and the living layer 6 cm. deep, with a lower edge tending to creep.

The calicles are almost superficial, about 1·25 mm. in diameter; the raised wall-ridge, consisting of single irregular rows of small straggling granules, traces a polygonal pattern over the whole surface, except in the forks. The walls seem to be formed out of continuous flakes, which are thick, slightly wavy, and with tilted ends; the pores in the flakes are few and small, and their edges, where they border the calicles, are deeply incised to produce the irregular septal tongues which may project from different levels of the wall. These septal tongues are broad, with rough edges, and there is only a trace of the typical radial symmetry in the incisions, which themselves represent the interseptal loculi. There is a large and conspicuous ring of pali, apparently in formula B, fig. 3. From the shallow fossa a small tubercle can be seen rising from the flakes which fill it up. The transverse section shows the immense development of the horizontal elements at the expense of the trabeculæ.

There are three specimens: (*a*) a small tuft showing the method of growth; (*b*) a single detached stem which fits on to *a*; and (*c*) a portion of the dead previous growth, one tip of which has a small plate-like colony, 2 cm. in diameter, growing out horizontally from it, and with edges slightly turned up. The character of its calicles and the resemblance between its section and the cross sections of the dead stems on which (and, presumably, from which) it grows, show that this is a small explanate stock of this same *Porites*.

Whether this disc is merely an accidental shape assumed by the creeping edge, or a new colony starting as a basal disc from the centre of which a new branching stock would have arisen, we have no means of deciding. If the latter, it is of great interest, for it is rare to find the earliest growth stage of branching forms.

Only one *Porites* having the skeleton built up mainly of the horizontal elements has hitherto been recorded, namely, the Singapore form (No. 7), Brüggemann's "*P. sacharata*"; several, however, are now known. In this, and in the Singapore form, we have two calicles of essentially the same type of structure, but differing considerably in detail: in *P. Singapore* 7 the flakes are larger and with fewer granules, and, further, the growth-form is quite different. No object that I can see is gained by uniting into one species all forms which show the same type of calicles; we should only be assuming knowledge which we do not possess. It is more philosophical to record the facts in tables, as is here done. The distribution of this type of calicle associated with other growth-forms will be given in the Analytical Tables at the end of this Volume.

a. A small stock.	Zool. Dept. 1904. 10. 17. 13.
b. A single stem detached from *a*.	Zool. Dept. 1904. 10. 17. 14.
c. A dead fragment with small disc (? a new colony in its earliest stages) attached.	Zool. Dept. 1904. 10. 17. 15.

FIJI ISLANDS.

16.* **Porites Fiji Islands (24)1.** (*P. Fidjiensis prima.*) (Pl. II. fig. 9.)

[Totoya (17 fathoms), coll. McGillivray (H.M.S. 'Herald'); British Museum.]

Syn. *Porites levis* Dana, Zooph. (1848) p. 559; pl. liv. figs. 5 *a–d.*

Description.—Corallum ramose, stems 2 mm. thick, ultimate branchlets 1 cm.; the rounded or slightly flattened stems and branches bend about and change too suddenly in thickness to possess elegance or beauty of form. In addition to the end twigs, which may be thin and nearly 3 cm. long, with their tips as if they had been pinched, small mammillate knobs about 1 cm. long may come off at any angle from the sides of the stems. The living layer may extend 9 cm.

The calicles are slightly over 1 mm. across, faintly pitting the surface, and are irregularly polygonal. The walls are thick, solid looking, and appear to be built up of large, semi-translucent frosted granules, heaped up without order. The septa are in the complete formula, very regular, thick, wedge-shaped near the walls, and tapering symmetrically towards the centre. Their edges are finely frosted, and their top edges tend to break up into square granules diminishing in size. The largest belong partly to the wall. The next are the septal granules, and the innermost are the pali. A deep, circular furrow separates the wall- from the septal-granules. The pali, usually five, are not conspicuous, hardly differing from the septal granules in size. The central tubercle, frosted like the other granules, is on the same level with the pali and of the same size, but is frequently flattened in the directive plane, so that the whole calicle is filled up with large, frosted granules. The interseptal loculi run up as narrow slits between the wall granules. On the basal parts of the stock the granules increase in size, the calicle depressions become shallower, the furrow round the septal granules is more marked, and a second furrow appears round the pali, so that the calicles are marked by sharp, concentric rings about the same width as the interseptal loculi.

This is almost certainly the same kind as the coral described by Dana as *Porites levis.* The exact locality among the Fiji Islands was not mentioned by Dana. The characters of the growth-form as above described, agree perfectly with those shown in Dana's figure, except that the Museum specimens are rather more stunted in growth. The general character of the granular surface, as given by Dana, is also the same. But he has drawn only one ring furrow, namely, that round the pali. This certainly appears in the basal parts of the stock, but the first to appear is that which separates the septal granules from the wall granules.

* There is no need to arrange these Fijian *Porites* in the order in which they were originally recorded; the bulk of the earlier records are from Dana's work. I prefer to begin with the actual specimens as supplying a surer basis from which to judge of the earlier descriptions.

The differences between this and the closely similar branching forms from *Tonga Islands 8* and *9*, depend upon differences of growth-form and upon the shapes of the granules. Both are built up of radiating trabeculæ, the tips of which form the granules. In this coral these tips seem to be larger, flatter, and more nearly square. It seems, also, as if the horizontal tissue is a little more pronounced than in *P. Tonga Islands 8* and *9*. Compare remarks there made, p. 39 et seq.

a. Labelled by Brüggemann "*Porites lævis.*" Zool. Dept. 56. 9. 24. 5.
b. „ „ „ Zool. Dept. 56. 9. 24. 6.

This is the only branching form of *Porites* from Fiji Islands in the National Collection. Two more were described by Dana, *Porites "nigrescens"* as certainly, and *Porites "cylindrica"* as doubtfully, from Fiji.

17. **Porites Fiji Islands** $_{(24)}$**2.** (*P. Fidjiensis secunda.*) (Pl. III. figs. 1–4; Pl. XI. fig. 3.)

[Kandavu, coll. H.M.S. 'Challenger'; Wakaya Reef, coll. J. S. Gardiner; British Museum.]

Under this heading I propose to group four specimens; in spite of remarkable differences in habit, they all have the same essential structure of calicle, and apparently the same growth-form.

Description.—The corallum is massive; its surface breaks up into lobules which are fairly uniform in size and shape, about 2 to 2·5 cm. across, and showing a slight but distinct tendency to be bluntly ridged, rather than round-topped. The valleys between the lobules are shallow, except where three meet, when they dip down steeply into small hollows 1 cm. deep.

The calicles vary on the different specimens from 1 to 1·5 mm. The walls all show a sharp, thin median ridge of fused trabeculæ, which rise to different heights; they are highest when the calicles are small and alveolate, lowest when the latter are large and shallow. On each side of the median ridge there is a ring of granules or flakes; in cases in which the calicles are small and deep and the skeleton light, these are seen to be the septal granules, but the whole aspect of the calicle changes when they are broad and flaky, as in the larger shallower calicles; they then form together a broad platform all round, just beneath the top of the median ridge. The septal formula is always complete (fig. 3, B); the four principal pali are very large. The ventral directive is continued into a keel, which, deep down in the fossa, represents a flattened central tubercle. On each side of this long directive the free septa bend sharply round just below the pali to form with it a trident. Still deeper down a clear columellar ring can be generally made out, with a varying number of attachments to the centre.

Specimen *a*, from Kandavu (Pl. III. figs. 1, 2; Pl. XI. fig. 3).

Syn. *Porites arenosa* (*partim*), Quelch (*non* Esper), Chall. Rep. xvi. p. 183.

A large, heavy mass, with extensive lobulate surface. The calicles are small, little over 1 mm. across. The septal granules, joined by short waists to the wall-ridge, are mostly large enough to unite, or nearly to unite, so as to form a ring of tissue, which turns the otherwise simple wall into a reticulum. The photographs show the differences between the calicles near the top and those near the lower edge of the stock.

a. Zool. Dept. 86. 12. 9. 290.

Specimen *b*, from Wakaya Reefs (Pl. III. fig. 3).

Syn. *Porites arenosa* var. *lutea* (*partim*), Gardiner, Proc. Zool. Soc. (1898) p. 257.

A very small stock, but already beginning to show the same type of lobulation as *a*. The calicles are, perhaps, a little larger. The septal granules are more flaky, and, while here making the walls reticular, there they form a shelf sloping from near the top of the wall-ridge down into the calicle.

The name "*arenosa*," given by Mr. Gardiner, was obviously suggested by Mr. Quelch's name for specimen *a*.

b. Zool. Dept. 1905. 1. 19. 1.

Specimen *c* is from the same locality. It is only a small chip. It shows a character of calicle seen only on part of *b*. The skeletal elements tend to be very thin and flaky, with ragged or finely echinulate edges. The calicles lose much of the stiffness seen in *a* and parts of *b*.

c. Zool. Dept. 1905. 1. 19. 2.

Specimen *d*, from the same locality (Pl. III. fig. 4), also part of Mr. Gardiner's var. *lutea*. This shows the same type of lobulation as *a* and *b*, but the calicles are much larger and shallower. The septal granules have expanded into large flakes, forming a broad level shelf or platform round the calicle, from the edge of which the septa project. The median ridge is conspicuous, though not high; it is now a thin connected string of frosted or finely echinulate granules. The large lateral pali are often V-shaped. The ring of pali appears a little more open than in *a*, and like those of *b* and *c*.

d. Zool. Dept. 1904. 10. 17. 16.

The fact that all these corals come from the same island group, have the same method of growth, or rather show the same peculiar form of surface lobule, and a strong similarity in septal and palic formulæ, while the differences in the aspect of the calicles can be attributed to the variations in development of one structural element—the septal granules—justifies Mr. Gardiner's grouping, which we have here followed. Flakes sloping from the wall-ridge into the calicle occur again—e.g. *P. Fiji Islands 18*—where, however, it is not so easy to see their homology with septal granules.

18. **Porites Fiji Islands** $_{(24)}$**3.** (*P. Fidjiensis tertia.*) (Pl. III. fig. 5; Pl. XIII. fig. 7.)

[Wakaya, coll. J. S. Gardiner; British Museum.]

Description.—The corallum forms thin, closely encrusting plates, from the surface of which there rise smooth, rounded mammillæ, 1 cm. high and 1·5 cm. thick. There is a large mammilla in the middle of the stock, with attempts to form others. The edge of the colony above the epitheca consists of a zone of incomplete calicles.

The calicles are small, about 1 mm. in diameter, as conical depressions. The walls show a thin median ridge consisting of a row of minute frosted granules; these rise from smooth, flat flakes which slope slightly downwards on each side into the calicle. The septa near the walls are broad tongues of the wall-flakes, and, when long, with jagged edges; each carries a frosted granule near its extremity; these are the septal granules and usually rise on the shorter tongues, which project from the top edge of the wall-flakes, while the pali most frequently rise from longer tongues of a lower level. The formula appears to be that shown on Diagram E, fig. 3, but it is very irregular. The four principal pali are the best developed, but none rise higher than the septal granules, or are distinguished otherwise than by position. The fossa, compared with the size of the calicle, is large and deep in the oldest stock. A minute columellar tubercle can sometimes be seen deep down.

There is one large specimen encrusting a *Pinna*; it is 7 cm. across. The symmetrical boss in its centre may indicate some foreign object grown over, but it strongly suggests the possibility of the stock being the explanate base of some branching *Porites*.

Partly covered over by the large stock (*a*) is a smaller one (*b*), which is thinner, and its calicles have not the deep central fossa; while a minute third stock (*c*), only 1 cm. in diameter, bleached and detached from the *Pinna*, shows that in the shallow calicles of very young colonies the radial symmetry is much more pronounced than it is in the deep calicles with their tiers of septal tongues.

a. Large stock on *Pinna*, with central boss.
b. Small stock on *Pinna*, partly covered by *a*. } Zool. Dept. 1904. 10. 17. 17.
c. Minute bleached stock, detached. Zool. Dept. 1905. 1. 19. 3.

19. **Porites Fiji Islands** $_{(24)}$**4.** (*P. Fidjiensis quarta.*)
(Pl. III. figs. 6, 7; cf. Pl. XIII. diagram fig. 8.)

[Wakaya Reef (lagoon), coll. J. S. Gardiner; British Museum.]

Syn. *Porites trimurata* (*partim*), Gardiner, Proc. Zool. Soc. (1898), p. 270.

Description.—The corallum forms massive cakes, some 3 cm. thick, with flat and gradually expanding tops. The upper surface is scored with shallow valleys, but the intervening mounds are low. The edge of the table-top is smooth and round, the colony extending some 2 cm. under the projecting edge.

The calicles are large, up to 1·75 mm., on the tops of the mounds, with minute intervening buds; they diminish to 0·5 in the bottoms of the valleys. The wall is a thick, rather coarse reticulum, with rounded pores; a median ridge with irregular granulated edges and sides, and with round pores, is well developed on the mounds; at the edges of the stock it is a smooth straggling thread running along the middle of the wall; when the ridge with part of the surface is worn off, the wall appears solid but for the canals or pores which penetrate it. Just below the edge of the ridges are irregular wall-granules, roughly corresponding with the septa. These latter are symmetrically arranged; they are frosted or granulated, the most conspicuous variation being a large symmetrical ring of twelve septal granules, inside which in the deeper calicles on the mounds the septa seem to slope away, so that their pali are only represented by one or two minute points; but wherever the calicles are shallower the pali rise up and form a symmetrical ring in the formula Diagram B (fig. 3, p. 19); both pali and wall granules are very minute and frosted. The columellar tangle is large, and its reticulum is so close and flaky as to appear dense at the bottom of the deep open fossa in the large calicles, but at the edges of the stock it comes nearer the surface, and the flattened central tubercle can be easily seen. The interseptal loculi form a conspicuous ring of holes in the nearly solid corallum when the surface is abrased. The fact that the skeletal elements all round the edges of the tableland are thinner, and the reticulum more flaky and open, that is, has much larger pores, shows conclusively that the stock grows out laterally round the edges.

The single specimen of this coral is a portion of a flat cake with projecting edges, such as is shown in the diagram, Pl. XIII. fig. 8. It may be regarded as an extreme form of the expanding-sheaf formation. Beneath the living colony it is rotten from the burrowings of a sponge. Mr. Gardiner united it with *Porites Ellice Islands 4*. I do not, of course, deny the genetic affinity of the two forms, which is indeed probable enough, but it seems to me safer to keep on the right side of the facts, and describe the variations, leaving the affinities to be worked out in the future. See further under the heading *P. Ellice Islands 4*.

The most remarkable feature in this *Porites* is the regular ring of twelve septal granules round the fossa of the deep calicles as if they took the places of the pali, which are always less developed in deep than in shallow calicles. They are, unfortunately, not well shown in fig. 6, because it is taken from above. Fig. 7 shows the character of the rapidly growing calicles all round the edge of the table top.

20. Porites Fiji Islands $_{(24)}5$. (*P. Fidjiensis quinta.*)

[Kandavu, coll. H.M.S. 'Challenger'; Wakaya Reefs, coll. J. S. Gardiner; British Museum.]

Syn. *Porites crassa et crassistellata* Quelch, Chall. Rep. xvi. (1886 ?) pp. 182, 183, pl. xi. figs. 2, 2*a*, and 4, 4*a*.

Description.—The corallum rises in the centre into a mound of small irregular nodules, while the edges of the stock creep outwards as a thin layer following the irregularities of the substratum. The creeping edge may be under 0·5 mm. thick.

The calicles average 1·25 mm. in diameter; they are round, and, except in the wrinkles between the nodular excrescences, sunk in the pits formed by the cœnenchymatous development of the walls. These latter foam up into thick round-topped swellings, which vary in aspect according to the thickness of the skeletal elements. The septal formula is complete, and the pali may be conspicuously developed; wall-granules are suggested on the steep sides of the cœnenchymatous margins of the calicles; but no ring of septal granules appears round the pali. The fossa is large; in its base can be seen a large columellar tubercle, which not unfrequently rises from a bar of the columellar tangle running in the plane of symmetry.

There are three specimens, all showing the same method of growth, with calicles of the same size and type. The aspects of the three are quite different, a fact which led Mr. Quelch to consider them to represent two distinct species. When, however, we add to the resemblances just mentioned in the calicles the fact that all three of them show the same kind of cœnenchymatous specialisation of the wall, bearing in mind that that specialisation is somewhat rare among the Poritidæ, we are naturally led to examine the differences very closely. These may, it seems to me, be due entirely to variations in the thickness of the skeletal elements.

Specimen *a* (the type of Mr. Quelch's "*crassistellata*") from Kandavu (l. c. Pl. XI. figs. 4, 4*a*).

The skeleton is thick, frosted, and crystalline. The cœnenchymatous swellings of the walls are not uniformly developed over the whole of the surface of the nodules, but make rings round single calicles and gyrating ridges. Young calicles open upon their swollen tops. Looked at under a pocket-lens, the swellings appear like dense piles of large glassy granules. The septa are broad and wedge-shaped, and the narrow slit-like interseptal loculi run back as deep gashes into the dense cœnenchymatous swellings. The ring of eight pali (fig. 3, B, p. 19) is very conspicuous. At the edges of the colony the swellings become more reticular, but the reticulum is flaky and the septa wedge-shaped flakes with toothed edges.

a. Zool. Dept. 86. 12. 9. 315.

Specimen *b*, from Wakaya reefs.

The cœnenchymatous swellings of the walls are here also irregular in size and distribution. The reticulum of the swellings is only slightly less dense, but that of the intra-calicular skeleton is not especially thickened, so that the septal formula is clear and conspicuous, and the interseptal loculi open and petaloid; the pali, and, at a lower level, the central tubercle, are conspicuous, but not frosted. In the valleys between the nodular uprisings of the surface the walls may be a simple irregular lattice, while in specimen *a* the walls are everywhere, even on the under surface, thick, and as if composed of solid flakes. Tabulæ are very numerous.

b. A small fragment. Zool. Dept. 1905. 1. 19. 5.

Specimen *c* (the type of Mr. Quelch's "*crassa*") from the "Reefs, Fiji" (l. c. Pl. XI. figs. 2, 2*a*).

The cœnenchymatous swellings are more evenly distributed over the whole surface, their

reticulum, though still coarse, is more open, and sometimes has large pores, making it a flaky filamentous foam. The swellings tend to overhang the calicles, which makes them look smaller. The pali are very pronounced. Zool. Dept. 86. 12. 9. 320.

The forms which follow are all from "Fiji Islands" without further information. I naturally assume that the main group is meant. These, therefore, come before the specimens from the island Rotumah, which lies at the extreme north of the group.

21. **Porites Fiji Islands** $_{(24)}$**6.** (*P. Fidjiensis sexta.*) (Pl. III. fig. 8; Pl. XIII. fig. 9.)

["Feejee Islands," coll. F. M. Rayner; British Museum.]

Description.—The corallum is explanate, with smooth surface, but rising into smooth, rounded mammillæ; it attains a thickness of 1 cm., the edges being less than 1 mm.

The calicles only pit the surface slightly, and are without sharp outlines, but apparently about 1 mm. in diameter. The walls are thick, flat, and solid looking, and as if composed of flakes, the edges and surface of which form opaque, chalky granules of no definite shape, sometimes even smooth and round (? due to corrosion), at others frosted. The thick, opaque flakes of the wall slope down on each side to form the broad jagged septa, which frequently fuse together laterally into broad solid triangles with ragged edges. The radial symmetry is greatly obscured; the complete number of interseptal loculi is rarely seen, while the coarse, jagged granules scattered on the wall seem to invade the calicle quite irregularly, and only rarely appear as a ring of pali. In the most symmetrical calicles this ring consists of five, and is sometimes surrounded by a ring of septal granules of the same size, but these, owing to the indefiniteness of the interseptal loculi and the width of the septa, often appear to belong to the wall.

This specimen is only a fragment of a colony which was evidently struggling with unfavourable circumstances. Its true growth-form is unknown. The specimen looks as if it might have been the explanate base of a cluster of mammillate mounds, or even branches. The single specimen is nearly covered over by a *millepore*, and the living colony is confined to one edge. Away from the edge it slopes up one side of a mammillate process, while some of its edges are creeping over the dead previous growth (see Pl. XIII. fig. 9). Some of the calicles have what I can only think to be pathological characters; the surface granules are swollen into large, white, erect, oval grains. Assuming the majority of the calicles to be normal, they somewhat resemble those figured by Esper for his "*Madrepora arenosa*" (Suppl. I., pl. lxv.).

The Museum specimen was named "*P. nigrescens* Dana" by Brüggemann, and so recorded in his MS. Catalogue. This identification is based solely upon the flaky walls, and ignores the very pronounced growth-form of Dana's coral. It is, as above suggested, possible that the specimen is a basal stage of a branching *Porites*, but we have no ground for assuming this, and still less ground for assuming that the form would be *P. nigrescens* (see *P. Fiji Islands 8*, p. 51).

a. Zool. Dept. 62. 2 4. 48.

22. **Porites Fiji Islands (24)7.** (*P. Fidjiensis septima.*) (Pl. III. fig. 9; cf. Pl. XIII. Diagram fig. 8.)

["Fiji Reefs," coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites arenosa* (*partim*) Quelch (*non* Esper), Chall. Rep. xvi. (1886) p. 183.

Description.—The corallum appears to have formed a thick, flat cake, with level but slightly wavy top, and slightly bulging sides, which are thick, round, and project over the substratum. The whole mass is over 5 cm. thick, and the living colony extends some 3 cm. round and under the edge.

The calicles are small, 1 mm. in diameter and under, and about 0·5 mm. deep. The walls have conspicuous median ridges consisting of single, usually straight rows of stout trabeculæ which are sometimes separate, in which case the ridge consists of a row of large square granules. In the angular calicles in the valleys these trabeculæ alone form the walls, but on the wave-like mounds of the table-top the septal granules swell and fuse to form a second wall inside the wall trabeculæ. Where the surface has been abrased, the whole thickened wall is very stout and almost solid. The septal formula is complete, but the septa contrast greatly with the stout walls; they are thin, glassy and fragile, and in all the deeper calicles project from different levels, so as to appear often quite irregular and with hardly any development of pali. In the shallow calicles on the under surface the walls are broad, flat, smooth flakes, which send long tongues with jagged edges sloping down each side into the calicles, radially symmetrical; and, in addition to the large frosted pali and the granules of the median ridge, are distinct traces of both wall- and septal-granules, with a central columellar tubercle almost on a level with the pali. In the deeper calicles this tubercle is only seen deep down connected by radial elements with a columellar ring, which is, however, at a still lower level.

The single specimen is only a fragment—apparently a large chip from the projecting edge of such a stock as that described and represented diagrammatically on Pl. XIII. fig. 8. There is not much of the top surface shown; there is a complete vertical section at least down to where the corallum is destroyed by a boring sponge. In this section the thick wall-trabeculæ can be distinguished from the thinner elements of the intra-calicular skeleton.

The growth-form is like that of *P. Fiji Islands 4*, but the edges are thicker and rounder. The photographs will show the differences between the calicles and those of *P. Fiji Islands 2*, with which Mr. Quelch placed it as Esper's "*arenosa*."

a. Zool. Dept. 86. 12. 9. 362.

23. **Porites Fiji Islands (24)8.** (*P. Fidjiensis octava.*)

[" Feejee Islands," coll. Wilkes Expedition, 1838–42.]

Syn. *Porites nigrescens* Dana, Zooph. (1848) p. 557 ; pl. liv. figs. 1, 1*a*, 1*b* ; pl. liii. fig. 9.
? Porites nigrescens Rehberg, Abh. Naturw. Verein Hamb. xii. (1892).

Description.—The corallum forms close tufts of erect stems, long, tapering, sinuous, sometimes fusing (" distantly coalescent ") and branching, with tips, some sharp, some blunt. Stems from 2·5 to 3·5 cm. thick at the base ; branchlets 8 to 12 mm. thick, and from 5 to 6·5 cm. long. It is alive for 15 to 20 cm. The calicles are large (1·5 mm.), excavate only at the growing tips. The septa are broad and granulous.

The clumps are 20 cm. and more high, and much branched. They blacken as they die, the septa appearing brown. Other growth-forms occur—e.g. single thick stems, 5 cm. thick and " divaricately " branching, the branchlets ending in sharp, tapering points.

The above is the original description. From the figures we gather that the walls are broad and flaky, that an open ring of frosted granules rises from the surface of the broad bases of the septa (wall- or septal-granules) and within, a ring of six pali ; no central tubercle is shown in the fossa. The transverse section shows that the horizontal elements are developed at the expense of the trabeculæ.

The sinuosity of the stems has naturally attracted attention, and suggested affinities which have nothing else to support them. The same character appears in Dana's *P. cylindrica*, from some unknown locality, probably the Fiji Islands.

With its striking growth-form and the excellent description and figures given by Dana, especially that of the section showing the immense development of the tangential skeletal elements (cf. *P. Tonga Islands 9*), the coral ought to be easily re-identified. Brüggemann suggested that *P. Fiji Islands 6* may have been a fragment of a base of a stock of this coral. On this, see remarks on p. 49 ; while Dr. Rehberg mentions a coral from the Pelew Islands, to which he gave this same name.

Dana's variety, "*mucronata*," from the Sooloo Sea, is referred to on p. 162.

24. **Porites Fiji Islands (24)9.** (*P Fidjiensis nona.*)

[" Feejee Islands," coll. Wilkes Expedition, 1838–1842 ; Paris Museum.]

Syn. *Porites contigua* Dana (non *Mad. contigua* Esper), Zooph. (1848) p. 560, pl. liv. figs. 6, 6*a*.
Porites ? danæ M.-E. & H., Ann. Sci. Nat. xvi. (1851) p. 32.*
Synaræa danæ Verrill, Bull. Mus. Comp. Zool. (1864) p. 43.*

Description.—The corallum forms low even-topped convex clumps composed of a compact tangle of angular stems of quite irregular shapes ; their tips are blunt and 3 to 6 mm. thick. The living layer is 6 cm. deep.

* This was one of the *Porites* the position of which in the genus Milne-Edwards and Haime doubted. The doubt was based upon the fact that the calicles were flush with the surface, and the walls being thick, there appeared to be a great development of cœnenchyma. Acting upon this hint, Dr. Verrill changed the generic name to *Synaræa*. See further, Introduction p. 9.

The calicles are superficial and obscure, indicated only by a minute fossa surrounded by six pali. The granules on the walls are scattered.

I was fortunate enough to find what appears to be one of the original specimens of this coral in the Paris Museum (No. Z 185*a*); it had been presented by M. Agassiz. The corallum is built up of thick, erect, flame-like processes. The surface granules are echinulate or frosted, distinct and rising from a smooth flat floor, as shown in Dana's fig. 6*a*. The septa are triangular tongues, and are arranged in the typical formula. There are six pali surrounding a conspicuous pinhole fossa.

The growth-form of this *Porites* is something like that of the form from Tahiti (*Porites Society Islands 3* = Verrill's *Synaræa convexa*), but the calicles are of an entirely different type (see p. 30).

A form said to resemble Dana's figures occurs at Samoa (see p. 33).

Esper's *Mad. contigua* was apparently a *Psammocora*, as Dana suggested.

25. Porites Fiji Islands (24)10. (*P. Fidjiensis decima.*)

["Feejee Islands," Wilkes Expedition, 1838–1842.]

Syn. *Porites conglomerata* Dana (*non* Esper), Zooph. (1848) p. 561, pl. lv. figs. 3, 3*a*.

Description.—The corallum is glomerate and as high as it is broad; the rounded top consists of a number of smooth tall hummocks, with sharp intervening valleys.

The calicles are "angular, quite shallow, flat-conical," 1·3 mm. in diameter. "The septa are very thin and acute."

This is Dana's original description. His figure 3*a* shows what appear to be simple ragged septa or interrupted (= perforated) walls and septa, without any clear development of pali. There are indications of a central columellar tubercle, but very minute.

There is no special reason to believe that this is the *Porites* from some unknown locality which Esper described and figured (Pflanzenth. Suppl. I., pl. lix*a*). The most striking feature of Esper's coral is its growth-form, which is not very much like that figured by Dana.

26. Porites Fiji Islands (24)11. (*P. Fidjiensis undecima.*)

["Feejee Islands," coll. Wilkes' Expedition, 1838–1842.]

Syn. *Porites fragosa* Dana, Zooph. (1848) p. 563, pl. lv. figs. 9, 9*a*.

Description.—The corallum is glomerate, rising into a mound which is highest in the centre ("surface subangular"), and covered with coarse lobes ("coarsely monticulose").

The calicles are "subangular, shallow," 1·3 mm. in diameter, and "plane at bottom." The septa are "obtuse."

This is Dana's original description. To it we must add the statement that one of his specimens was 30 cm. high and 17 cm. broad, and the interior of the stock is said to be of a dense but uniform texture throughout.

From the figures we gather that the walls are simple, but thickly frosted; the septa are also frosted and in the typical formula, but with feebly developed pali. There is a conspicuous columellar tubercle.

The method of growth appears to have somewhat resembled that of *P. Ellice Islands 3*, p. 65, and is not common.

Professor Studer, in 1878, described a form from the reefs in the back of Kaiserin Augusta Bay, Bougainville, Solomon Islands, which he thought might be of the same species as this coral described by Dana.

27. **Porites Fiji Islands (24)12.** (*P. Fidjiensis duodecima.*)

["Feejee Islands," coll. Wilkes Expedition, 1838–1842.]

Syn. *Porites favosa* Dana, Zooph. (1848) p. 564, pl. lv. figs. 4, 4*a*.

Description.—The corallum rises as an erect, smooth, stout column with a flat top, and humps or lobes appear here and there on its sides. The living layer extends to its base.

The calicles are deep, with tall sharp walls, about 1·5 mm. in diameter. The septa, as seen in the figure, seem to be rather deep down in the calicle, wavy, jagged and thick, although Dana describes them as being "acute and durable."

The single specimen was 10 cm. in height and 7·5 by 5 cm. in breadth.

The character of the septa shown in Dana's figure, the irregularity of their fusings, and the absence of all traces of pali make me think that this, like his "*P. limosa,*" is a *Goniopora*. We must, however, remember that Professor Verrill, who re-examined the specimens, left Dana's names for both these corals unchanged, and the evidence for this coral being a *Goniopora* is not quite so clear as it is in the case of *G. limosa* (see Part II.) or his *P. conferta* (= *Mad. conglomerata*, Esper's pl. lix.)

28. **Porites Fiji Islands (24)13.** (*Fidjiensis tertiadecima.*)

["Feejee Islands," Dana, coll. Wilkes Expedition, 1838–1842.]

Syn. *Porites cribripora* Dana, Zooph. (1848) p. 564, pl. lv. figs. 5, 5*a*.

Description.—The corallum appears to build up glomerate masses by continual encrusting layers 6–12 mm. thick, with thick edges involuted or folded under. The surface is raised into smooth, rounded, wave-like hummocks, separated by smooth, round, concave valleys.

The calicles are small, about 1 mm. in. diameter, "puncture-like" and deep. The walls appear to be built up of the septal striæ, crowded together irregularly—that is, showing little trace of radial symmetry; the parts of the septa which project into the fossa are deep down and obscured, but they send up small pali which appear as minute points in the opening of the calicle.

This description is founded on Dana's text and figures. The "puncture-like" calicles and the walls as shown in the figure are of interest. Dana called attention to the resemblance of this coral to that figured No. 4, pl. xli. in Ellis and Solander's "Zoophytes" (1786). But until the original of that coral is discovered, it is useless adding to the guesses which have been made as to what it was.

29. **Porites Fiji Islands (24)14.** (*P. Fidjiensis quartadecima.*)

["Feejee Islands," coll. Wilkes Expedition, 1838–1842.]

Syn. *Porites informis* Dana, Zooph. (1848) p. 565, pl. lv. figs. 6, 6*a*, 6*b*, 6*c*.
Synarœa informis Verrill, Bull. Mus. Comp. Zool., l. (1864) p. 42.*

Description.—The corallum is amorphous, and tends to produce stout, gibbous rather than columnar masses; the lobed surface is sparingly "erose." The summit is not flat-topped.

The calicles are superficial, and scarcely distinguishable; they appear as minute pin-hole fossæ surrounded by groups of frosted granules, which are the six pali. The walls are wide and covered with scattered granules, unlike the pali.

We can gather further from the figures that the walls and septa were composed of flat flakes, so that in section the horizontal elements were almost more pronounced than the vertical (fig. 6*c*.) There appears also to have been a ring of septal granules running irregularly round the pali.

The living polyps are pale yellow, surrounded by brown (see Dana's coloured fig. 6*a*); the tentacles are "obsolete."

Compare this with *P. Fiji Islands 15*, in which the skeletal elements show the alternative extreme of specialisation. The single specimen was 7·5 cm. high and 10 cm. in diameter.

30. **Porites Fiji Islands (24)15.** (*P. Fidjiensis quintadecima.*)

["Feejee Islands," coll. Wilkes Expedition, 1838–1842.]

Syn. *Porites monticulosa* Dana, Zooph. (1848) p. 566, pl. lv. figs. 7, 7*a*, 7*b*, 7*c*.
Synarœa monticulosa Verrill, Bull. Mus. Comp. Zool., l. (1864) p. 42.*

Description.—The corallum is amorphous, tending to rise into erect columns or lobes 2·5 to 7·5 cm. thick and 5 cm. high, with round, truncated tops. The surface is everywhere angularly "erose," or monticulose, the lateral monticles crowded, often sub-triangular and ascending, never coalescing into carinate ridges; smaller on the summits.

The calicles are superficial, scarcely distinguishable. The whole surface is a mosaic of large frosted granules of equal sizes and at uniform distances apart; according to Dana's fig. 7*b*,

* See footnote, p. 51.

these seem to be arranged as follows: There is a ring of six very large pali, which surrounds a minute fossa; round the pali is a ring of twelve granules, which appear to be wall granules, while a single row of granules may intervene between calicle and calicle. The septal granules are either absent or fused with those of the wall or with the pali.

The living polyps are brown, the "lips semilunate" and yellow, the tentacles whitish and "obsolete."

This is obviously a cœnenchymatous *Porites*, as was also the one last described; but the two are not closely allied, for whereas this is covered with large granules, which represent the tips of stout trabeculæ shown in fig. 7*c*, it is the horizontal elements which are most pronounced in *P. Fiji Islands 14*.

The single specimen was 14 cm. high, and from 11–12 by 7·5 cm. at the base.

31. Porites Fiji Islands (24)16. (*P. Fidjiensis sextadecima.*)

["Feejee Islands," coll. Wilkes Expedition, 1838–1842.]

Syn. *Porites lichen* Dana, Zooph. (1848) p. 566, pl. lvi. fig. 4.
? Porites lichen Quelch, Chall. Rep. xvi. (1886), p. 181 (see *P. Sandwich Islands 7*).
non *Porites ? lichen* Bassett-Smith, Ann. and Mag. Nat. Hist. (6°) vi. (1890) p. 456 (see *P. China Sea 14*).

Description.—The corallum is encrusting, 3 mm. thick, with undulate surface, margin subacute, often flexed upwards, and free for 8 mm.

The calicles are shallow, but with the walls as thin ridges, which run over the surface as a reticulum.

See observation under next heading.

32. Porites Fiji Islands (24)17. (*P. Fidjiensis septimadecima.*)

["Feejee Islands," coll. Wilkes Expedition, 1838–1842.]

Syn. *Porites reticulosa* Dana, Zooph. (1848) p. 567, pl. lvi. fig. 3.

Description.—The corallum is encrusting, scarcely at all free round the margin, with undulate surface, from which mammillæ and tubers arise.

The calicles are neatly angular, shallow, 1·5 mm. across, plane at bottom. The walls are again prominent as thin ridges, running, as in the last form, like a reticulum over the surface. The septa are thin.

Milne-Edwards and Haime suggested that these two corals belong to the same species of *Goniopora*, but Dr. Verrill, who had the advantage of re-examining Dana's types, did not accept the suggestion. Dana's figures also make it clear that they cannot be classed under one heading. There is only one encrusting *Porites* in the National Collection from the central

islands of the Fiji group—viz. No. 6. It shows a faint thin ridge running along the middle of the otherwise broad, flaky walls, but not sufficiently pronounced as to give the impression shown in Dana's figure.

Among the specimens from the most northerly island of the group, Rotumah, are encrusting forms whose walls show at the surface like a reticulum of thin ridges, but in no case are the calicles shallow; they are, on the contrary, often so deep that the pali are hardly developed.

We must wait for further material from these islands before we can hope to obtain any certain light upon either of these forms.

There is a specimen in the Paris Museum from the Collection "Agassiz," and labelled *P. reticularis* I. Fidji. But this shows no features sufficiently marked as to remind one of Dana's figure.

33. Porites Fiji Islands $_{(24)}$18. (*P. Fidjiensis octavadecima.*) (Pl. IV. fig. 1; Pl. XIII. fig. 10.)

[Rotumah, reef near Solkopi, coll. J. S. Gardiner; British Museum.]

Syn. *Porites viridis* var. *apalata* (*partim*) Gardiner, Proc. Zool. Soc. (1898) p. 268.

Description.—The corallum is thin, encrusting, of quite irregular outline, following the irregularities of the substratum, and even folding under. Colony about 1 mm. thick at the edges.

The calicles are polygonal and deep, very variable in size, mostly small, but with groups of larger ones up to 1·25 mm.; these are usually congregated on the rounded elevations of the surface. The walls are characterised by their sharp ridges, which are smooth and thread-like or wavy and irregular, variously but not strikingly denticulate. Indications of the septa appear immediately below the edge of the ridge as small blunt points, sloping downwards into the fossa; these lengthen very gradually, the septa being represented by vertical rows of blunt points or knobs, irregularly fused together. The typical fusion of the septa with one another is only indicated. There are no pali, the base of the fossa deep down being occupied by a rather coarse reticular columellar tangle.

This is the description of the small encrusting specimen which Mr. Gardiner mentions (l. c. p. 269). It may be that Mr. Gardiner's suggested affinity between this and the types of his var. *apalata* (see next heading) is correct, but the striking differences between the two ought to be more clearly emphasised.

In favour of Mr. Gardiner's view that they are genetically related, we note that they come from the same locality and are of the same colour, the living polyps being a bright dark green —the dead skeleton a pale ashy grey—while some of the specimens (*b* and *d*) of the next form show also the encrusting method of growth. Even a resemblance between the calicles can be traced.

I would call attention to the character of the septa and the absence of pali in the deep calicles of this form (compare *P. Ellice Islands 10*).

34. **Porites Fiji Islands** (24)**19.** (*P. Fidjiensis nonadecima.*) Pl. IV. figs. 2, 3, 4; Pl. XIII. fig. 11.)

[Rotumah, reef near Solkopi, coll. J. S. Gardiner; British Museum.]

Syn. *Porites viridis* Gardiner, Proc. Zool. Soc. (1898) p. 268, pl. xxiv. figs. 1, *b*, 2.*
Porites viridis var. *apalata* (*partim*) Gardiner, ibid. fig. 1, *c*.

Under this heading I have grouped five specimens whose affinities have already been pointed out by Mr. Gardiner. They differ from one another in most striking ways, yet close analysis shows them all to be variations of one special type of modification.

General description.—The corallum may either be encrusting, with thin edges, but with the surface raised into solid rounded ridges, separated by deep, sharp, irregular valleys, or as solid hemispherical mounds with a marked tendency for the upper surface to be broken up into rounded hummocks, separated by narrow fissures or infoldings.

The calicles are conspicuous and funnel-shaped, with sharp wall-ridges which make them polygonal; when the ridges are absent the calicles are round, mostly just under 2 mm. in diameter. The walls are a stout flaky reticulum which varies greatly in texture, and upon these variations depend the extraordinary differences of habit seen in the specimens, no two being alike. The wall-ridge is only slightly developed upon the convex surfaces, but in the valleys it forms the whole wall. Below the ridge the septa begin at once to appear as flakes sloping downwards into the fossa; deeper down they lengthen, and, according to their thickness and the depth of the calicle, form various more or less incomplete septal patterns.

The polyps in life are a very bright dark green.

Specimens *a* (Pl. IV. fig. 2) and *b* (the types of Mr. Gardiner's variety "*apalata*").

The corallum is massive and hemispherical, showing continuous growth with formation of pendent edges; the upper surface is so crowded with rounded and gyrating hummocks as to appear convoluted. The walls of the calicles are characterised by the sharp median ridge, with its sloping septal flakes very pronounced, and with clean cut jagged edges. The longer lower flakes seldom get nearer to producing the typical septal formula than by occasionally touching and fusing with adjacent flakes. A coarse flaky reticulum with large meshes fills the base of the irregular fossa. Except in the shallow calicles on the pendent edges there are no pali, and the radial symmetry is generally obscured. The section (of *a*) shows a coarse reticulum in which all the elements are uniformly very stout, the horizontal elements being somewhat more conspicuous than the trabecular. Tabulæ are very numerous.

In *b*, which is a large fragment, the calicles are slightly deeper than in *a*. There are a few double calicles, or at least calicles with supernumerary septa; one of these abnormal calicles was

* On this figure see remark on specimen *b*.

figured by Mr. Gardiner (l. c. pl. xxiv. fig. 2). The great majority show the usual twelve septa fused in the regular manner. The skeletal elements are hollowed out by an alga. The colony shows well developed edges to the successive growth periods.

a. Zool. Dept. 1905. 1. 19. 7.
b. Zool. Dept. 1904. 10. 17. 18.

Specimen *c* (the largest specimen of "*P. viridis*") (Pl. IV. fig. 3).

The corallum is massive, but while at one part the edge is folded under, at another it bends upwards, and creeps outwards like that of specimen *e*. The massive end is smooth except for one small patch of valley formation. The walls are of a much lighter reticulum than in *a*. The median ridge is less pronounced, and the septal flakes are seldom so broad; they have frosted tips, and the lower ones fuse, and thereby produce the typical septal formula more often than in *a*. Minute frosted pali rise from these septal fusions, which are most marked in the shallowest calicles. That part of the stock where the edge is folded under is especially noteworthy; the calicles are deep, with tall, thick, round-topped walls consisting entirely of a filamentous reticulum without any trace of radial symmetry. A similar kind of wall appeared in specimen *a* of *Goniopora North-west Australia 6* (Vol. IV., p. 63, Pl. IV., fig. 6).

The skeletal elements are hollowed out by a boring alga. The horizontal and trabecular elements are about equally well developed.

c. Zool. Dept. 1904. 10. 17. 19.

Specimen *d* (Pl. IV. fig. 4).

A small massive growth, with convoluted surface like *a*. The calicle walls are a light flaky reticulum, without sharp median ridge, except in the valleys. The wall-flakes frequently run out into thin narrow septa, and all stages of septal fusion can be seen with corresponding formation of pali. At the sides the calicles are shallower, and the septa more flaky, with a more complete ring of rather larger pali; the central tubercle is very minute.

The skeletal elements of this specimen are hollowed out by an alga, here and there right up into the tips of the wall reticulum; it is possible that the absence of the median ridge may be partly due to the friability thus caused, and consequent abrasion.

d. Zool. Dept. 1905. 1. 19. 8.

Specimen *e*.

A small encrusting colony, freely following the irregularities of the substratum; with very thin edges and crumpled surface. The calicles are slightly deeper, and the walls a much finer and closer reticulum than in the foregoing. A small patch, however, has calicles, exactly like those of specimen *a*, thus compelling us to unite forms which in other respects could have only been united by guesswork. The wall-reticulum is at times a tall, thick, round-topped, almost filamentous foam, like that found on specimen *c*, where the colony is folding over.

e. Zool. Dept. 1904. 10. 17. 20.

We have here a most instructive series of five specimens. Had the extraordinary differences seen in them (cf. figs. 2, 3, 4) been distributed so that each specimen had but one uniform type of calicle, they would necessarily have all been described separately. But the calicles are not uniform over any of the specimens, and the two extremes of wall formation are found on one and the same colony.

35. **Porites Fiji Islands** (24)**20.** (*P. Fidjiensis vicesima.*) (Pl. IV. fig. 5.)

[Rotumah (boat channel*), coll. J. S. Gardiner; British Museum.]

Syn. *Porites parvistellata* (*partim*) Gardiner (? Quelch), Proc. Zool. Soc. (1898) p. 272.

Description.—The corallum forms a massive, roughly conical mound. The top is round, and the sides slope gently outwards. The specimen shows no free edges.

The calicles are small but conspicuous, polygonal, averaging about 1 mm. across. The wall, which is not thick, is yet strong looking, and, when not actually reticular, is almost solid, with a sharp median ridge composed of fused trabeculæ; beneath this ridge the wall appears to be thickened by the broad bases of the septa, usually without the formation of any reticulum; here and there, however, parts of rings of synapticulæ appear like portions of an inner wall. The septa are smooth and short, often too short to meet; all stages in the formation of the typical septal formula can be seen. The fossa is deep, round, and seldom obscured by the presence of a columellar tubercle. The interseptal loculi are round and conspicuous.

It is quite possible that this Fiji form may be closely allied genetically with Quelch's small calicled form from the New Hebrides, but their structural differences, which, if we wish to get any insight into the variations of the genus, it is our business to emphasise, are very great. The calicles of the latter are rather smaller, and their walls more uniformly fragile and porous, with ragged, irregular denticulation. The septa are longer, much thinner, and more fragile. See the description and figure of *P. New Hebrides Islands 1* (p. 81, Pl. VIII. fig. 1).

In his original description, Mr. Gardiner mentions two specimens as coming from Rotumah. This is apparently an oversight; the second specimen is *P. Ellice Islands 10* (for the description and figures of which, see below, p. 73).

a. Zool. Dept. 1905. 1. 19. 9.

36. **Porites Fiji Islands** (24)**21.** (*P. Fidjiensis prima et vicesima.*) (Pl. IV. fig. 6; Pl. XIII. fig. 12.)

[Rotumah (boat channel *), coll. J. S. Gardiner; British Museum.]

Syn. *Porites alveolata* Gardiner (*non* M.-E. & H.), Proc. Zool. Soc. (1898), p. 268, pl. xxiv. fig. 1*a*.

Description.—The corallum is massive, and forms smooth, rounded lobes with thin edges, which are closely adherent and bending under.

* Its greatest depth at low tide is 8 ft., see Gardiner's account of the reefs in Proc. Camb. Phil. Soc., ix. (1898) p. 441.

The calicles are small, uniformly 1 mm. in diameter, sub-circular, and deep. The walls, though not thick, are a close, flaky reticulum, mostly with a slight denticulate median ridge, the component denticles or trabeculæ being tall and thick. The septa begin to project some way below the top of the ridge, and almost always form the typical septal formula; the free secondaries (see, without reference to septal granules, E, fig. 3) on each side of the ventral directive are quite short, as is also the dorsal directive. The pali, seen from above, are not conspicuous, but seen laterally, rise as stout, tapering rods. The fossa is deep and circular, without columellar tubercle. The interseptal loculi are round and open.

This *Porites* differs mainly in the character of its walls from *P. Fiji Islands 20*; the septa are exactly alike; they are in both very short, and the pairs which fuse enclose an angle of nearly 60°.

The Red Sea form, called by Milne-Edwards "*alveolata*," is, as I gather from my notes made in the Paris Museum, very different from this (see below, in the section dealing with Red Sea *Porites*.

a. Zool. Dept. 1905. 1. 19. 10.

37. **Porites Fiji Islands** $_{(24)}$**22.** (*P. Fidjiensis secunda et vicesima.*) (Pl. IV. figs. 7, 8; and Diagram, fig. 8, Pl. XIII.)

[Rotumah, coll. J. S. Gardiner; British Museum.]

Syn. *Porites tenuis* Gardiner (? Verrill), Proc. Zool. Soc. (1898) p. 276.

Description.—The corallum forms flat-topped cakes some 4–5 cm. thick. The edges of the cake, which project laterally some 4–5 cm. above the substratum, are thick and rounded. The top surface is slightly wavy; the under surface of the projecting edges is quite smooth.

The calicles are everywhere flush with the surface, except on the outermost zone of the projecting edges, where growth is apparently most rapid; here (Pl. IV. fig. 7) the thin walls rise as ragged, incomplete membranes a little above the surface. Seen from above, the calicles of the uppermost surface appear as polygonal areas, uniformly 1 mm. across and separated by very thin ragged or frosted lines, which, under the microscope, are seen to be the low median ridges of reticular walls. This reticulum is fairly uniformly composed of this median ridge with a single ring of synapticulæ, which tend to expand into flakes, making shelves on each side of it. The septa are prominent. The pali, in formula B, fig. 3, as fine frosted granules inconspicuous to the naked eye, rise to the level of the top of the wall-ridge; the two smaller granules on the free ventral secondaries appear to be parts of an outer ring of septal granules (see E, fig. 3). The small columellar tubercle rises nearly as high as the pali, and rests on conspicuous radiating strands without formation of a visible columellar ring.

On the under surface the frosted pali and wall-granules gradually enlarge to form ultimately a frosted mosaic, in which the calicles become less and less recognisable (Pl. IV. fig. 8).

In section the skeleton is light and very trabecular; judging from the depth of the colouring matter and from the tabulæ, the polyps penetrated about 3·5 mm. below the level of the walls on the upper, but much less on the lower surface.

This *Porites* is quite unlike any other of the Fiji forms in habit, yet close examination shows it to belong to the group. Its median wall-ridge, the regular structure of the wall-reticulum, the structure for which Mr. Gardiner has suggested the term "trimurate," the sinking of the ridge to the level of the general surface, and lastly the growth-form, are all characters exemplified by Fiji forms, but still more by those from Ellice Island.

The specimen is only a broken portion of an edge, with no other indication as to its true shape or position in life than can be gathered from the characters of the calicles. Two of the calicle modifications are given in the figures. Fig. 7 shows the calicles of the expanding edges, where growth is rapid and the skeletal elements are smooth and flaky, and the reticulum is fluent. On the upper surface the skeleton is more regular and rigid and with frosted granules, while on the lower surface (fig. 8) the granules and the wall-flakes are swollen enormously, and the calicles but just recognisable.

a. Zool. Dept. 1905. 19. 1. 11.

38. **Porites Fiji Islands** (24)**23.** (*P. Fidjiensis tertia et vicesima.*) (Pl. IV. fig. 9.)

[Rotumah, coll. J. S. Gardiner; British Museum.]

Syn. *Porites ? cribripora* (Dana) Gardiner, Proc. Zool. Soc. (1898) p. 276.

Description.—The corallum is small, thin and encrusting, about 1 mm. thick, and with irregularly wavy or wrinkled surface.

The calicles are very small, under 1 mm., and, when not drawn out of shape, nearly circular; they are shallow, but have very conspicuous walls, which are thick only in comparison with the diameter of the calicles. They seem to be built of thin, smooth, horizontal flakes which slope downward on each side into the fossa, and along the tops of the flakes are flattened, frosted or ragged granules, which are mostly arranged as thin septal striæ running radially, but not symmetrically so, over the walls, and round the edges of the stock out to the rim of the epitheca. The septa are ragged tongues of the wall flakes: the uppermost run but a short way, the second tier carries the pali, and below these again flakes, with a few pores, run right across the calicle. The radial symmetry is not marked, though the pali tend to show irregularly the formula D, fig. 3 (p. 19). A central tubercle, short and stout, rises from the flakes which form the base of the fossa. The interseptal loculi are very irregular and inconspicuous.

The marked flaky texture of this stock convinces me that it is not an early encrusting stage of some other growth-form, but that this is its normal form. Mr. Gardiner, in spite of the temptation arising from the similarity in general habit, rightly hesitated to class this with his group "*exilis*," one of which, viz. that next described, is also from this locality. Both have flaky walls, but in this specimen alone are they smooth and flat, in the next they rise up to form a light flaky reticulum.

A small prominence on the surface of the colony is due to the rising up of a worm-tube, which is encrusted by the coral.

a. Zool. Dept. 1905. 1. 19. 12.

39. **Porites Fiji Islands** (24)**24.** (*P. Fidjiensis quarta et vicesima.*) (Pl. V. fig. 1.; Pl. XIII. fig. 13.)

[Rotumah, 3 fathoms, coll. J. S. Gardiner; British Museum.]

Syn. *Porites exilis* (*partim*) Gardiner, Proc. Zool. Soc. (1898) p. 275, pl. xxiv. figs. 1, 8.

Description.—The corallum has a thin encrusting base with thin edges (1 mm.). The centre thickens, and its surface rises into small mounds; as the growth-periods succeed one another, the centre rises as an irregular cluster of mammillations some 6 mm. thick and 10 mm. high, but fusing to form thicker compound mammillæ.

The calicles are about 1 mm. in diameter, very shallow and sub-circular. The walls are low and thick for the size of the calicles; under the microscope they consist of a light elegant reticulum of smooth, horizontal or gently sloping flakes attached to trabeculæ, which may either be invisible at the surface or rise above the flakes and swell into frosted knobs; the flakes are perforated by neat round holes, and their edges are cut out into elegant curves, with intervening tongues which run out as the beginnings of septa; one or two may even extend far enough to carry pali. The majority of the septa come from a lower level. The developed septum is not especially flaky, and the interseptal loculi are large. The pali have no fixed formula, but show several different arrangements; they are everywhere conspicuous as an open ring of separate granules round a central tubercle, which is large and rises to the height of the septa. A columellar ring is generally conspicuous, and the tubercle often rises from thick radial spokes meeting in its base. The vertical section is open and distinctly trabecular, with great numbers of tabulæ.

Mr. Gardiner may have been right in grouping this Fijian form with specimen *a* of *P. Ellice Islands 1* as specimens of one and the same "species," for in habit they are all closely alike, but there are differences which, in the total absence of evidence, may for all we know characterise the representatives of the different localities. For instance, in this Fijian coral the centre is not only thickened, but raised into a cluster of mammillæ from which the expanding base slopes away all round. This is a very different growth-form from that of the Funafuti specimens. Too much stress, of course, cannot be laid upon growth-form; great differences in it may be due to very trifling differences in the calicle skeleton. For example, in this very case the calicles are characterised by the growth of the trabeculæ in height; this naturally raises and lightens the flaky reticulum, and may well give the impulse to the formation of the mammillæ, whereas the short trabeculæ of the Funafuti specimens would leave the stock thin, flat, and encrusting. A much longer series of specimens can alone decide the question of the true affinities.

Mr. Gardiner's fig. 8 is probably taken from this specimen, for the columellar ring is a much more conspicuous object here than it is in the Funafuti specimens of his *P. exilis*, although the difference is not brought out in the collotype reproductions (cf. Pl. V. figs. 1, 2).

There is an unlabelled fragment with calicles exactly like the above. It has the thick central region with the same trabecular structure; the white chalky character of the epitheca is also the same. In Mr. Gardiner's text he implies that only the mammillate specimen came from

Rotumah. The point is a very important one, for if this fragment were (as I would like to believe it to have been) from Rotumah also, then we should have the Rotumah variation, so far as we know, confined entirely to Rotumah, and showing a definite distinction from the Funafuti specimen (for Mr. Gardiner's two other specimens from Funafuti belong to one and the same stock). See observations under *P. Ellice Islands 1.*

The photograph shows the base and part of the side of one of the mammillæ. Here and there wall flakes are shown devoid of trabeculæ. But the whole photograph shows conspicuous trabecular development.

a. A nearly complete stock. Zool. Dept. 1905. 1. 19. 13.
b. A fragment (? from Funafuti). Zool. Dept. 1904. 10. 17. 21.

It is possible that the *Porites cylindrica* of Dana ought to come in this group, but as Dana was not sure of its origin, it is better to describe it provisionally among forms of unknown or uncertain locality. (See Part II.)

ELLICE ISLANDS.

Note on the Ellice Islands Group.

According to Mr. C. Headley (see Memoir, iii. part 6, of the Australian Museum, Sydney, 1898, p. 349) the Funafuti reefs, as compared with those "of Queensland, New Guinea, or New Caledonia," are very poor in corals, the smaller reefs within the lagoon supplying the greater number. I may note, also, that Mr. Gardiner's collection was made almost, if not entirely, from within the lagoon. Neither Mr. Gardiner nor Mr. Headley discovered any branching forms. Professor Sollas, however, succeeded in finding two forms, one of which certainly would be called branching (see *P. Ellice Islands, 16* and *17*); but whether they were from the lagoon or from the outer reefs, there is no information.

40. **Porites Ellice Islands** [17]**1.** (*P. Elliciana prima.*) (Pl. V. fig. 2; Pl. XIV. fig. 14.)

[Funafuti lagoon, 7 fathoms, coll. J. S. Gardiner; British Museum.]

Syn. *Porites exilis* (*partim*) Gardiner, Proc. Zool. Soc. (1898) p. 275, pl. xxiv. figs. 1, *n*, 8.

Description.—The corallum forms thin, horizontal, ear-shaped stocks which, supported by thick, wrinkled epitheca, project freely. All the projecting part is very thin, but the skeleton may greatly thicken near its attachment, when the same light trabecular texture appears as was described above for *P. Fiji Islands 24.*

The calicles are about 0·75 mm. in diameter, very shallow, sub-circular in the central regions of the stock, but showing a tendency to be arranged in curved rows which straighten out towards the edges of the stock; hence at this part the calicles are very nearly diamond-shaped.

The walls are low, and composed of a rather close flaky reticulum, the flakes being mostly horizontal and broad, with few pores; the knobs and ridges rising from the surface of the flakes are often frosted at their tips, as are also the edges of the flakes where they project as septa into the calicle. These ridges on the wall flakes are as a rule quite irregular, but sometimes they are radially arranged, though the septa do not show any marked radial symmetry. The pali form a large open ring: the full number (eight) can often be seen. A central tubercle rises nearly to the height of the pali. A columellar ring can sometimes be seen, but many of the calicles are very shallow, and their fossæ seem early to be closed up by flakes with few pores. Round the edges of the stock it is noticeable that the directive plane tends to point towards the growing edge.

This coral was classed with *P. Fiji Islands 24* by Mr. Gardiner as of the same species, and certainly the calicles are constructed on the same plan, and the differences may all be unessential. But the simple facts are, that the Funafuti coral forms a thin freely-projecting ear-shaped stock, with edges curling up, while the Rotumah coral thickens in the centre and rises into mammillæ, and, further, the calicles differ, as shown in the figures. How far we should be justified in assuming the genetic affinity of the two corals, so long as we have no more material evidence, seems to depend upon the locality of the un-labelled fragment mentioned above (see *P. Fiji Islands 24*). As there stated, in structure it might be almost a fragment of the Rotumah coral, but Mr. Gardiner's text appears to imply that it comes from Funafuti. (See further under *P. Fiji Islands 24*, specimens *a* and *b*.)

a. Zool. Dept. 1905. 1. 19. 14.

41. **Porites Ellice Islands** $_{(17)}$**2**. (*P. Elliciana secunda.*) (Pl. V. fig. 3; Pl. XIII. fig. 15.)

[Funafuti, 7 fathoms, coll. J. S. Gardiner; Cambridge University Museum.]

Syn. *Porites superfusa* Gardiner, Proc. Zool. Soc. (1898) p. 274, pl. xxiv., figs. 1, *m*, 7.

Description.—The corallum is explanate, and loosely encrusts the layers built up by previous growths. The edges are about 1 mm. thick, here and there free. The upper surface is roughened by the development of cœnenchymatous knobs, ridges, and large irregular smooth-topped plateaux, 1 to 1·5 mm. high.

The calicles are small, about 1 mm. in diameter and less; between the ridges and plateaux they are densely crowded, and their walls then consist of single loose rows of thin trabeculæ; but on the plateaux they are nearly 1 mm. apart and sharply sunk, like pits, into the cœnenchyma. These wall-plateaux are remarkable for the fineness and continuity of the surface reticulum, which is covered with minute, erect granules. Between scattered calicles, on these level plateaux, young buds in all stages of development pit the surface. The septa are deep down and obscure, but the pali are very conspicuous as an open ring of tall, tapering, well-spaced rods rising to the level of the plateaux. There are six—five very large—principals, with one minute palus on the dorsal directive; this regularity of the palic formula shows that the septa are arranged typically. The fossa is frequently occupied by a columellar tubercle. In vertical

section the corallum becomes nearly dense below the living layer, while the skeleton of the living layer itself is strikingly but very loosely trabecular, the individual trabeculæ being far apart and also tapering towards the surface. The horizontal elements are sparse.

This coral is of exceptional interest because of the effects apparently produced by numbers of minute worm-tubes which open on its surface. They appear for the most part on the plateaux; when they occur in any of the troughs they always seem to give rise to a development of the same proliferation of surface reticulum as that which constitutes the plateaux. It is impossible to avoid the suggestion that the cœnenchymatous upheavals may be entirely caused by the presence of these foreign organisms. There is some reason to believe that the worm-tubes communicate with one another within the dense coral below the living layer. If the characters of the specimen are due to the presence of the worms, we have another case in which we are entirely at a loss to say what are the ordinary characters of the coral without the worms. It might, for instance, be a specimen of the next form in which the trabeculæ are pronounced, the pali tall, and the wall showing a strong tendency to rise into cœnenchymatous swellings. Against this suggestion we must note that the calicles of the next coral are larger and with a different septal formula, and the colour a light fawn instead of the pale grey of this coral, the living colony of which was green (see Gardiner, l. c.).

In addition to the principal colony, there is, attached to its basal crust, a very young stock in a small round saucer of epitheca, not 3 mm. in diameter. This shows the same tendency to form cœnenchymatous walls, though there are no worm-tubes.

The only known specimen is in the Cambridge University Museum.

42. Porites Ellice Islands (17)3. (*P. Elliciana tertia.*) (Pl. V. figs. 4, 5; Pl. XI. fig. 2.)

[Funafuti (lagoon shoals), coll. J. S. Gardiner and W. J. Sollas; British Museum and Cambridge University Museum.]

Syn. *Porites purpurea* Gardiner, Proc. Zool. Soc. (1898) p. 269, pl. xxiv. figs. 1, *d*, 3.

Description.—The corallum is massive and "monticulose," its centre rising into a cluster of short, erect, irregular lobes or mammillæ from 1 to 1·5 cm. thick and up to 2 cm. high, sometimes forming together low hemispherical mounds, sometimes conical stocks 12 cm. high (Pl. XI. fig. 2) and 6 cm. thick at the base. There is a very pronounced edge formation, the living layer extending right down over the base; the thick edges are sometimes free and pendent, thinning rapidly to about 2 mm.

The calicles (cf. Pl. V. fig. 5) crowded and conspicuous, and as if sunk into the upraised wall-reticulum; they average about 1·25 mm. across, with many small buds appearing in the wall-angles. The walls consist of a bold flaky reticulum; its flaky elements are especially conspicuous at the growing tips of the lobes, but on their steep sides the flakes are not so broad, and consequently are less visible; they are further obscured by the granulated or frosted tips of the trabeculæ rising all over the surface. The intra-calicular skeleton is very bold

and open. The septa are thin, but conspicuous and rugged. The septal formula is complete. The number of pali varies according as there are any on the two small secondaries composing the ventral triplet. A columellar tubercle, sometimes flattened, rises in the open fossa, but is far shorter than the tall pali. The columellar tangle seems to be sparse, and shows no special regularity of structure. The interseptal loculi and the spaces round the central tubercle are open and deep.

Three specimens of this coral were collected and described by Mr. Gardiner. The walls seem everywhere to foam upwards, and it is this character which clearly gives rise to the development of the mammillæ. The vertical sections show a very strong development of trabeculæ, very wide apart, especially when forming part of the intra-calicular skeleton; they seem to be slightly more compact in the walls. The horizontal elements are also very thick, and bear witness to the flaky texture of the walls. The specimens should be compared with *P. Fiji Islands 24*, which is also mammillate, with a similar flaky skeleton of open reticulum, but all on a smaller scale.

"The colour of the living colony with the polyps expanded is a dark purple."

a. (See Pl. XI. fig. 2.) Zool. Dept. 1904. 10. 17. 22.
b. Zool. Dept. 1905. 1. 19. 15.

One other specimen of this coral is in the Cambridge University Museum.

In addition to the above are two specimens (*c* and *d*) which appear to belong here, both having essentially the same type of calicles, and all being from the same locality.

c. This specimen (cf. Pl. V. fig. 4,) appears as if it might be a chip from a basal edge, rather wider than any of the three colonies above described possess, otherwise its characters are exactly like the edges of these forms. The calicles are smaller and more crowded, and the walls thinner, but they still show a tendency to throw up cœnenchymatous ridges. The intra calicular skeleton is of the same open character, but the skeletal elements are all smooth: the calicles being smaller, they are less regularly symmetrical (fig. 4). The section shows the same pronounced trabecular structure, but the trabeculæ are thinner and the spaces between them consequently wider, while the horizontal elements, so conspicuous in the types, are here but feebly developed. I am inclined, on this account, to regard the specimen as a fragment of another colony, and to attribute the structural differences to rapidity of growth in thickness. This would account for the smaller and less regular calicles, and the smoothness and filamentous character of the skeleton at the surface.

c. Zool. Dept. 1904. 10. 17. 23.

The specimen *d* is a free nodule, which began by encrusting a piece of dead coral. This latter can still be seen, with great numbers of the "edges" of the encrusting coral around it. The calicles are again smaller, but the type is the same, and the walls show the same woolly appearance of the surging reticulum.

d. Zool. Dept. 1904. 10. 17. 24.

43. **Porites Ellice Islands** (17)**4**. (*P. Elliciana quarta.*) (Pl. V. fig. 6; Pl. XIV. fig. 16.]

[Funafuti, coll. W. J. Sollas; British Museum.]

Description.—The corallum, the complete growth-form of which is unknown, rises into small rounded nodules or nodulated branches, the surfaces of which, otherwise smooth and round, rise here and there into smaller knobs and excrescences.

The calicles are 0·75 mm. in diameter and flush with the surface at the sides, but slightly larger and deep funnel-shaped on the growing tips. The wall consists of a system of broad, crisp, flattened flakes, in tiers above one another. At the growing top these flakes seem to be thrown up edgewise, in order to make tall membranous wall-ridges. There is even a third kind of wall formation, viz. where fresh knobs are starting; it consists of a thick, open, filamentous reticulum. The septa in the lateral calicles run out from the edges of the wall-flakes; they are irregular both in shape and position, some as thick triangular tongues, others as strands or as knobs; some come from the uppermost tier of wall-flakes, others from a lower tier; their radial symmetry is, however, preserved, and their typical unions can be made out. The five principal pali are well developed. The fossa may either be deep and open, or closed by the columellar tangle, which consists of a few thick strands. From these a minute central tubercle sometimes rises.

In section the trabeculæ are thin and wavy, and fairly far apart. The horizontal elements are as well developed as the trabeculæ. The unbleached stock was a bright olive green.

The only specimen is a single detached knob, 2 cm. long, 1 cm. thick, and 3·5 cm. broad. Its stalk of attachment was flattened and about 7 mm. thick. Compare its flaky walls with those of *P. Fiji Islands 24*, but they are here much broader as compared with the width of the calicle, and at the tip turn up into wall-ridges.

a. Zool. Dept. 1904. 10. 17. 25.

44. **Porites Ellice Islands** (17)**5**. (*P Elliciana quinta.*) (Pl. V. figs. 7, 8, 9; cf. Diagram fig. 8, Pl. XIII.

[Funafuti, lagoon, coll. J. S. Gardiner; British Museum and Cambridge University Museum.]

Syn. *Porites trimurata* (*partim*) Gardiner, Proc. Zool. Soc. (1898) p. 271.

Description.—The corallum forms rounded flat-topped cakes, with rather sharp edges, which project 4 cm. free over the substratum. The under-surface is alive for some 2 cm. under the edge. The table-top is wavy.

The calicles on the top (fig. 7) are 1·5 mm. in diameter, crowded and neatly rounded in the bases of the polygonal areas made by the sharp wall-ridges. These are loose, straight rows of trabeculæ with feathery tips, and are consequently denticulate; seen from above, the

ridges are thin, wavy, and irregular. The septa begin very near the top of the wall-ridge, as small irregular projections often expanding into T-shaped flakes. Deeper down, these flakes are more prominent, meet and fuse, and together form an inner synapticular wall, which forms the true inner rounded skeleton of the calicle within the larger irregular polygonal areas circumscribed by the wall-ridges. This inner wall is not here very symmetrical or regular, and there is a tendency for it to melt down with the wall-ridge into a reticulum.

The septa are very thin, but are conspicuous owing to the frosted granules and the large plate-like pali, which show that the septal formula is typical. The pali form together a large ring, which at first sight appears very irregular, and to consist of a far greater number than is typical for *Porites*; and, further, being flattened, they are seen not to be radially symmetrical. These appearances are due to the fact that the large pali of the primaries slope towards but do not fuse with the smaller pali of the secondaries, hence each principal palus is represented by its two elements not fused together. It is a V-shaped body, but with the points not touching. The fossa is large and open, with a very thin central tubercle. Deep down beneath this the columellar tangle is circular and compact.

Round the projecting sides of the stock the skeleton tends to become an open flaky reticulum, indicating that this part of the colony was growing rapidly. On the under surface (Pl. V. fig. 8) the T-shaped flakes which thicken the wall-ridge become very pronounced, and form a shelf all round the calicle; while the septa become more conspicuous and echinulate, the plate-like pali are resolved into so many distinct echinulate granules, and are thus less conspicuous.

The section is strongly trabecular, the individual trabeculæ varying greatly in thickness.

This flat-topped growth-form, already described in the *Porites* of the *Fiji Islands* (see Nos. 4, 7, and 22), here occurs again in this Ellice Island group (see, for example, Nos. 6, 9); it is so far unknown elsewhere (see Introduction, p. 22).

The coral is peculiar in the arrangement of its pali. As a rule, when in large deep calicles the septa slope and only fuse deep down (see Introduction, pp. 18, 20), the pali—which at times seem to owe their existence to the fusions of the septa—are not developed. Here we have septa with very pronounced pali sloping towards one another but only fusing deeper down. The fact that the primary pali are so much larger than the secondary is of importance; in *Goniopora* it sometimes appeared as if the pali were associated with the secondaries rather than with the primaries.

Mr. Gardiner has called attention to the close similarity between *P. Fiji Islands 4* and this coral by uniting them under one specific name, "*trimurata*." This name, as described in the Introduction, p. 16, I have applied to a method of wall-thickening which is common in *Porites*. The calicles of the two forms are built on the same essential plan, but are larger in the Fiji form, and the rings of pali are not so conspicuous. We have no means yet of knowing whether the likeness is due to close genetic affinity, or to parallel developments under the influence of environments which closely resemble one another.

Fig. 6 is from the upper, fig. 7 from the lower, surface.

a. A large fragment from an edge of a flat-topped growth. Zool. Dept. 1904. 10. 17. 26.
b. Zool. Dept. 1905. 1. 19. 16.

There is another specimen, *c* (Pl. V. fig. 9), with a different growth-form, but which may, as suggested by Mr. Gardiner, come under the same heading.

The specimen is a fragment of a massive block, with rounded and apparently smooth surface. The calicles are of the same type as those of the last form, but the whole skeleton is lighter and more open. The wall-ridge shows a tendency for the trabeculæ, though here and there seen to be separate, to fuse together to form a smooth, solid membranous ridge raised above the surface. The peculiar flattened and non-fusing pali are again seen, but owing, perhaps, to the comparative smoothness of the thin septa, the aspect of the calicles is very different, for the ring of large open interseptal loculi make the calicles look like dark round spots, considerably larger than those on specimen *a* (cf. Pl. V. figs. 6, 9). The "trimurate" character is more visible than in *a*. I would account for the difference as due to the different growth-forms. The rounded mass was apparently growing rapidly at the top, hence the openness of the skeleton and the smoothness of its elements. The flat-topped specimen *a* was growing but slowly at the top, and the skeletal elements were thicker and more granular or echinulate. At the projecting edges, where growth was apparently rapid, we get a type of calicle more similar to that of this specimen.

If this association of the specimens be correct, it would show that the table-topped growth-forms are accidental, that is, *a* may have reached the surface of the water, and its growth may have been solely lateral, *c* may have been sufficiently below that level, and have been still growing upwards. On the other hand, it is also clear that what is known as the "expanding sheaf formation" might also account for the form of any single table-topped specimen (cf. Introduction, p. 16).

c. Zool. Dept. 1904. 10. 17. 27.

45. **Porites Ellice Islands** (17)**6.** (*P. Elliciana sexta.*) (Pl. VI. figs. 1, 2.)

[Funafuti (lagoon), coll. J. S. Gardiner; British Museum.]

Syn. *Porites umbellifera* (*partim*) Gardiner, Proc. Zool. Soc. (1898) p. 271.

Description.—The corallum appears to have been a flat-topped growth, with thin, sharp projecting edges, under which the colony was alive for 1·5 cm. The upper surface is irregularly humpy, rather than wavy (cf. Diagram fig. 8, Pl. XIII.).

The calicles are all flush with the surface, about 1·3 mm. in diameter. The median ridge of the wall is thin, very perforated, hence sometimes discontinuous, and echinulate; it appears as a thread not raised above the surface, and separated from the inner synapticular wall by a ring of irregular pores *which do not correspond with the interseptal loculi*; but where the septa meet this ring there is frequently a large, frosted, sometimes radially flattened, granule. The septa are very thin, laterally roughened rather than echinulate, and typically arranged. The pali are frosted rods, and show chiefly formula C, fig. 3, p. 19, in a rather small ring; the five principals being large, mostly rounded and very frosted, the palus on the dorsal directive being small. A thin, flattened central tubercle rises to the level of the pali, and forms a central rod from which four or five strands radiate symmetrically to join a columellar ring beneath the pali. Owing to the thinness of the septa, the interseptal loculi and other spaces are large and open.

On the under surface the walls are thick and covered with a delicate frosted reticulum.

The septa and pali all run together as fine frosted ridges, the directive sometimes joining the flattened columellar tubercle to form a keel right across the calicle.

The single specimen is only a fragment from the projecting edge of the stock. It was classed by Mr. Gardiner as of the same species as the next form, and it is very probable that the next may be but a rounded growth-form of this coral, yet the differences in the sizes of the calicles cause me to hesitate to class them together. See below.

A peculiar striation runs through the calicles of the under surface radially outwards. It is shown in Pl. VI. fig. 2, running from left to right.

a. Zool. Dept. 1904. 10. 17. 28.

46. **Porites Ellice Islands** $_{17}$**7.** (*P. Elliciana septima.*) (Pl. VI. fig. 3.)

[Funafuti (lagoon), coll. J. S. Gardiner; British Museum.]

Syn. *Porites umbellifera* (*partim*) Gardiner, Proc. Zool. Soc. (1898) p. 271.

Description.—The corallum is massive, and with smooth rounded surface. The complete form is unknown, the specimen being only a small chip.

The calicles are mostly under 1 mm.; in essential structure they are like those of the last form, but in aspect they are very different. The skeletal elements are smooth instead of frosted, the wall-ridge is stouter and continuous, the synapticular ring is also stouter and therefore closer to the wall-ridge. The septal apparatus is of the same type, but is sunk slightly beneath the surface; the septa and pali, and indeed, all the intra-calicular elements are smooth, and even tend to be flaky and less symmetrical than in the preceding form. The interseptal loculi are again large and open, and make the calicles look like dark round spots crowded on the smooth white surface.

It will be noted that, as far as one can judge from the specimen, this coral differs from the last in growth-form and in the thickness, and absence of frosting, of the skeletal elements. It is possible that the differences may again be referred to differences in position in the water (cf. specimens *a* and *c* of No. 5), and that this is but a massive form of *P. Ellice Islands 6*. But in this case, the calicles of the round form are smaller, and the skeletal reticulum is not much lighter but only smoother than that of the flat-topped form.

a. Zool. Dept. 1905. 1. 9. 17.

47. **Porites Ellice Islands** $_{17}$. (*P. Elliciana octava.*) (Pl. VI. fig. 4; Pl. XIII. figs. 17, 18.)

[Funafuti (lagoon), coll. J. S. Gardiner; British Museum.]

Syn. *Porites arenosa* (*partim*) Gardiner (*non* Esper), Proc. Zool. Soc. (1898) p. 272.

Description.—The corallum is massive, rounded, and with edges closely adherent. The surface is smooth or but slightly wavy.

The calicles are crowded, separated only by sharp, thin wall-ridges, 0·5 mm. high;

they are variable in size, the larger being 1·5 mm. in diameter. The wall-ridge is conspicuous, thin, smooth, and very wavy, sometimes zigzag; seen sideways, it is membranous and porous, and with ragged edges. The inner synapticular wall is seldom complete, and mostly fills in the angular spaces between the circular septal system and the more polygonal wall-ridges, but these spaces are not so marked as they would be if the ridges were straighter and less flexible. When the inner wall is present its skeletal elements are thin and smooth, and with the wall-ridge make a very open large-meshed wall-reticulum. The septa slope downwards to make funnel-shaped depressions, and are exceptionally thin and very delicately echinulate; they do not always fuse, and consequently the pali, which are delicate jagged points, are not well developed. The fossa is fairly deep; its base is occupied by a rather close columellar tangle, mostly without central tubercle except in the lateral calicles, in which the skeletal elements are coarser and the pali better developed.

The single specimen of this beautiful form is an oval mass 10 cm. long, 6 cm. across, and 6 cm. high. It appears to have become detached owing to the presence of a sponge which has burrowed through its substance and made the base rotten. The sponge apparently follows through the whole mass close under the living colony, and many oscula open on its surface, and always through an individual calicle, that is, never destroying a wall. There can hardly be a doubt but that the specimen is closely related, for instance, to No. 5, but a comparison of the photographs will show how striking are the differences, which may be due to the stimulus of the sponge burrowing beneath the living layer.

a. Zool. Dept. 1904. 10. 17. 29.

There is another specimen, *b*, from the same locality, the calicles of which, in spite of the difference in the wall-ridges, have the same sloping septa and of the same character, and on this account I propose to class it with this. It may be described as follows:—

(Pl. XIII. fig. 18.)

Syn. *Porites arenosa* (*partim*) Gardiner (*non* Esper), Proc. Zool. Soc. (1898) p. 272.

Description.—The corallum is massive, with smooth round top. The lower edges are closely adherent, and either bent under or outwards in thin sheets, which encrust and form a solid mass with the remains of other corals.

The calicles vary greatly in size—the largest are 2 mm., the smallest, which occur in groups in the slight concavities of the encrusting sheets, are often under 0·75 mm. The median ridge is as conspicuous and a little thicker than, but not quite so high as in *a*; it is straight, smooth, and stout; seen from the side, it is a nearly solid membranous ridge, level-topped or slightly jagged. The inner synapticular wall is nowhere regularly developed, it is most complete in the largest calicles, but for the most part it simply fills in the spaces between the angles of the polygonal ridges and the circular septal system. When developed it consists of the same smooth skeletal tissue as the wall-ridge. The intracalicular skeleton is like that of *a*.

b. Zool. Dept. 1905. 1. 19. 18.

48. **Porites Ellice Islands 19.** (*P. Elliciana nona.*) (Pl. VI. figs. 5, 6.)

[Funafuti (lagoon), coll. J. S. Gardiner; British Museum.]

Syn. *Porites arenosa* (*partim*) Gardiner (*non* Esper), Proc. Zool. Soc. (1898) p. 272.

Description.—The corallum is flat-topped, with wavy surface, and thick rounded edges projecting freely, under which the colony is alive for 2 cm. Where the edge does not overhang, life may extend 4 cm. down, and a creeping edge appears adhering closely to the dead previous growths or to other bodies.

The calicles are densely crowded, separated only by thin, raised wall-ridges; they vary in size, the larger being 1·3 mm. in diameter. The wall-ridge consists of a nearly compact row of trabeculæ, the tips of which are round frosted granules, which together form a continuous thread. Within this ridge, and nearly from its edge, septal granules begin to appear; beneath the top ring of granules, a ring of horizontal flakes occurs, and these meeting those on each side of them there is an approach to the formation of a flat shelf running round the calicle. The septa are extremely thin, but conspicuous owing to the crisp frosted granules and pali, for in addition to the wall granules, there is also usually a ring of very minute septal granules. The pali are small, and form an oblong ring of eight, in which the *septal granules* seem to supply all but the four principals (see Introduction, p. 20, and E, fig. 3). The central tubercle is represented by a long, thin, flat plate, deep down; it may divide into two small granules. On the under side of the edge of the stock the granular system is all nearly level with the surface (see fig. 6), and is complete and symmetrical, the granules and the wall ridge being here sharply echinulate rather than merely frosted.

This form seems to come halfway between *P. Ellice Islands 8* and *10*; the septa are long and thin, but made conspicuous by being frosted as in the former, but there is a strong tendency for the basal or wall portion of the septa to fuse as flakes to form a shelf round the calicle; this shortens the septa, as in *P. Ellice Islands 10*. Further, the septa do not slope downwards into the funnel-shaped fossa, but develop small but distinct pali.

We have already had occasion to refer to the flat-topped growth-forms with projecting and rapidly growing edges. In all cases hitherto the description has been based entirely upon a fragment broken off from one of these edges. In this specimen we fortunately have the complete form, but not quite so symmetrical as shown in Diagram fig. 8, Pl. XIII. (on this form see Introduction, p. 22). This may, perhaps, be accounted for by its having come early in contact with other corals. Its base, for instance, incorporates a fragment of what appears to have been a *Montipora*.

49. **Porites Ellice Islands** (17)**10**. (*P. Elliciana decima.*) (Pl. VI. figs. 7, 8; Pl. XIV. fig. 19.)

[Funafuti (lagoon), coll. J. S. Gardiner; British Museum.]

Syn. *Porites arenosa* (*partim*) Gardiner (*non* Esper), Proc. Zool. Soc. (1898) p. 272.
Porites parvistellata Gardiner (*non* Quelch), ibid.

Description.—The corallum rises as a smooth-topped rounded mass, with closely adherent edges; the sides of the stock are either steep or bending outwards to encrust masses of dead coral all around.

The calicles vary greatly in size, the larger being 1·5 mm. in diameter; numbers of small buds appear, like minute solid rings, raised up on the angles between the calicles. The wall-ridge is everywhere conspicuous, and is mostly a smooth solid ridge without pores, and with but slight traces of its composition out of trabeculæ, although patches here and there show both these characters; in parts the wall may even be a reticulum. In association with this solid ridge is the tendency seen over the greater part of the upper surface to form a smooth continuous shelf round the calicle below the edge of the wall; from the edge of this shelf the septa project. That this shelf is formed by the bases of the septa is clearly shown, for in those cases in which one or two septa project directly from the wall-ridge above the shelf, their basal sections are usually broad flakes. The septa when springing from the edge of the shelf are short and often rise almost at once as frosted granules. There is consequently a very large number of these granules running round the fossa, recalling the condition seen in *P. Ellice Islands 5*. The fossa is open and deep, a columellar tubercle sometimes appearing deep down.

There are three specimens, one a large irregular mass, one of Mr. Gardiner's *P. arenosa*, and two small stocks, the larger of which Mr. Gardiner suggested might be related to the *P. parvistellata* of Quelch (see, however, *P. New Hebrides 1*, p. 81). In this last named specimen there are two remarkable variations on the type of calicle above described. On one side of the stock (Pl. VI. fig. 8 *) the synapticular shelf is only irregularly developed, and then it is seldom complete, but perforated; the calicles are very deep, both fossa and interseptal loculi; the septa fuse sufficiently to send up the four principal pali as stout conspicuous rods nearly as high as the wall. On the opposite side of the stock the wall-ridge is frosted, and is sometimes thick and with a solid shelf (Pl. VI. fig. 7 *), at others almost a reticulum; the septa slope down into the fossa, frosted, thick, and without any developed ring of pali. The fossa is funnel-shaped and not deep.

There can again be no doubt that these are all related together, and to the last forms. But how are we to deal with the astonishing differences if we simply group them under one name with a common description?

a. Zool. Dept. 1905. 1. 19. 20.
b. Zool. Dept. 1904. 10. 17. 30.
c. Zool. Dept. 1905. 1. 19. 21.

* The collotypes do not sufficiently bring out the distinction between the wall-ridge and the shelf.

In connection with this form may be mentioned a free stock discovered by Mr. Gardiner at a depth of seven fathoms. It shows an astonishing variation in its calicles. There is everywhere the conspicuous wall-ridge showing most of the specialisations above described under the different headings. There is sometimes a shelf with short septa, at others the septa are long and thin, as in *P. Ellice Islands 8*; while on one side of the stock the calicles show conspicuous rings of septal granules on the same level with the pali.

One might perhaps infer, since this specimen which was a free rolling mass has calicles at one spot like those of No. 8, and at another like those of No. 10, that that fact established a link between those numbers. And this it certainly does, but how are we to interpret it? That there exists some affinity between the corals of this whole group, from Nos. 5 to 10, and perhaps 11, is already admitted, and was indicated by Mr. Gardiner's names, but what the nature of this affiinity is has to be discovered; we have no data for any decision, and guessing serves no useful purpose. We have no alternative but to describe them under symbols for reference. Further, if we knew the exact relationship, we should even then have to invent a method by which it could be recorded in the symbols.

d. A detached stock. Zool. Dept. 1904. 10. 17. 31.

50. Porites Ellice Islands $_{(17)}11$. (*P. Elliciana undecima.*)

(Pl. VI. fig. 9; Pl. VII. fig. 1; Pl. XIII. fig. 20.)

[Funafuti lagoon; coll. J. S. Gardiner; British Museum.]

Syn. *Porites arenosa* (*partim*) Gardiner (*non* Esper), Proc. Zool. Soc. (1898) p. 272.

Description.—The corallum is massive and rounded, with edges closely adherent and bending under. The surface is raised into mounds and flattened ridges separated by open valleys, about 0·5 cm. deep.

The calicles are crowded and flush with the surface, with straight sides, and hence very angular, 1·5 mm. in diameter. The wall-ridge, seen from above, is a thin echinulate thread, which, seen sideways, is often continuous and straight, seldom divided into separate trabeculæ. The calicle is occupied by two rings of small but very echinulate granules, reaching to the level of the wall, the outer ring the septal granules (not T-shaped), and the inner ring the pali. Beneath these can be seen parts of the shelf running round the calicle, and dimly the septal and columellar skeletons. Seen sideways, the granules appear as tall spikes, the inner ring—the pali—being the larger; but there are great variations in the size of the septal granules (see Pl. VII. fig. 1). The pali form a rather compact ring of six—that is, four larger principals and two small directives. These latter are often flattened, and here and there a palus is joined to a septal granule, to make a long radial plate.

There are two variations on this calicle on this same specimen; in one the wall-thread and the granules become horizontal flakes, so strikingly echinulate as to form a pattern quite unique—this is on one side of the stock, and perhaps simply a growth stage. A small

portion of this is shown in Pl. VI. fig. 9, in the top left-hand corner, while the general type of the calicles on the upper surface is shown in the lower right-hand corner of the same figure. The other is on the under surface, and is the normal condition of the basal calicles; the wall-thread and granules are merely thickened, and the shelf of flakes is more conspicuous. The development of the shelf out of T-shaped flaky septal granules is not so clear in this form as as it sometimes is. Here and there the flakes come from the wall-ridge without any stalk, but their septal origin can be traced in many of the lateral calicles.

In this case not only do the calicles differ from any of the preceding, but the growth-form, with its rather sharp ridge and valley system (see Pl. XIII. fig. 20), is also different from that of any other Funafuti *Porites*.

a. Zool. Dept. 1904. 10. 17. 32.

51. Porites Ellice Islands (17)12. (*P. Elliciana duodecima.*)

(Pl. VII. figs. 2, 3; Pl. XIII. fig. 21.)

[Funafuti lagoon; coll. J. S. Gardiner; British Museum.]

Syn. *Porites arenosa* var. *lutea* Gardiner, Proc. Zool. Soc. (1898) p. 273.

Description.—The corallum is massive, and forms smooth, round, or oval stocks with closely adherent edges.

The calicles are fairly uniform, in size about 1·25 mm., shallow, but with raised walls. The character of these walls varies enormously in different parts of the stock; at one end the wall-ridge rises as a single straight wall obviously composed of fused trabeculæ, whose frosted tips look like compact rows of round granules. In this case the inner synapticular wall is hardly traceable, but the pali are thick, frosted, and rise as tall round-topped rods as large as the wall trabeculæ. Over the greater part of the upper surface of the stock the wall-ridge disappears; it appears to melt down, apparently with an inner wall-ring, to form a rather close flaky reticulum (Pl. VII. fig. 2), the elements of which only show a little frosting here and there. The septa in these calicles are very thin, but hardly smooth or straight. The pali are again large, and echinulate rather than frosted. On the lower parts of the stock this reticular wall tends to solidify, but shows traces of its median ridge. The pali are then less prominent, because surrounded by a ring of septal granules as large as themselves (see the asterisk on Pl. XIII. fig. 21). A third modification of the wall found in this specimen is unique within the genus (Pl. VII. fig. 3). The walls are flat and solid, but striated by the septa, which, when the walls are narrow, are arranged radially across them, when broad, as parallel lines—reminding one of the genus *Agaricia*. These striæ project into the calicle as short thick septa, so crowded as to be almost in contact, and narrowing the calicle aperture, which is almost entirely filled by the ring of pali.

The palic formula seems to be mainly D, fig. 3 (p. 19), with five principals and one small directive. The columellar tangle is large and dense, appearing high up among the intra-calicular skeletal elements.

This *Porites* is quite remarkable in the variations in the walls.

a. Zool. Dept. 1904. 10. 17. 33.

52. **Porites Ellice Islands** (17)**13**. (*P. Elliciana tertiadecima.*)

(Pl. VII. figs. 4, 5; Pl. XIII. fig. 22.)

[Funafuti, coll. J. S. Gardiner; Cambridge University Museum.]

Syn. *Porites arenosa* (*partim*) Gardiner (*non* Esper) Proc. Zool. Soc. (1898) p. 272.

Description.—The corallum is massive, the surface smooth, with round, low waves, but the complete form is unknown.

The calicles are 1 mm. in diameter, nearly flush with the surface, varying from angular to sub-circular, owing to the wall angles being often reticular. The walls (Pl. VII. fig. 4) over the greater part of the surface are thin ridges, finely zigzag, membranous, with very scanty perforations and denticulations. These ridges are raised slightly but uniformly above the surface. A variation on this type of wall appears (Pl. VII. fig. 5) on one of the sides of the stock (see the asterisk on Pl. XIII. fig. 22); it is reticular but flat-topped, and flush with the surface, the septa in this case showing as thin radial striæ running halfway over the wall, and ending as if against a zigzag ridge, which, however, is no longer visible at the surface. Seen from above, the angles of the thin normal walls, when thickened into a reticulum, appear as a very fine open filamentous network (Pl. VII. fig. 4), but sideways the network is seen to consist of vertical laminæ. The septa appear faint, thin and incomplete; but present in the full formula. The four principal pali contrast strongly with the septa, being conspicuous V-shaped granules; seen sideways they are smooth rods which rise high, almost to the level of the walls. The other four pali are variously developed, sometimes present, sometimes absent, and always smaller than the principals. A very minute central tubercle is nearly as tall as the pali; and deep down among the open interseptal loculi a symmetrical columellar tangle can be made out with radial strands running to the centre.

In the vertical section the laminate character of the skeleton is clearly seen in the walls and septa; in transverse section the rings of interseptal loculi can be always traced.

There is certainly some affinity between this coral and that last described. The fact that both produce lateral calicles with striated walls, elsewhere hardly known in the genus, is significant. But beyond this bare fact the skeletal details are not alike (cf. Pl. VII. fig. 2 with fig. 4, and fig. 3 with fig. 5).

The only specimen is in the Cambridge University Museum.

53. **Porites Ellice Islands** $_{(17)}$**14.** (*P. Elliciana quartadecima.*) (Pl. VII. fig. 6; Pl. XIV. figs. 2, 3.)

[Funafuti (lagoon), coll. J. S. Gardiner; British Museum.]

Syn. *Porites arenosa* var. *parvicellata* Gardiner, Proc. Zool. Soc. (1898) p. 274.

Description.—The corallum is massive; the complete form is unknown. The upper surface, which seems to have been compressed as a ridge, is crossed transversely by smooth short waves. The living layer extends only 2 cm. down the sides.

The calicles are 0·85 mm. in diameter nearly, flush with the surface, angular in the valleys, sub-circular on the wave-crests. The wall-ridge is thin and straight round the angular calicles, thicker and zigzag round those which are subcircular; it is porous and sometimes with ragged, sometimes with denticulate, edges, the denticles being square-topped; they are the flattened tips of trabeculæ. The thickening of the wall in the angles of the round calicles seems to be due to the presence of large septal granules, which sometimes run together to form parts of an inner wall. These septal granules often project just below the edge of the wall-ridge, while below them again, short, very thin septa, interrupted, angularly bent, and slightly frosted, meet to form the typical pali system. The whole circle of eight pali is usually present, but only the four principals, which are often V-shaped, are conspicuous. The fossa is large but very inconspicuous; the columellar tubercle is minute, thin and flattened, and the floor appears to be solid.

In section the trabeculæ are thick and close, with short thick junctions.

Mr. Gardiner describes this *Porites* as being in life of a golden green colour, and common on all the shoals in the lagoon at Funafuti, but never uncovered by the tide. It has again the same type of calicle as the last two forms described, but much smaller. All three have the V-shaped pali; they are clearly shown in Pl. VII. figs. 2–6.

The specimen appears as if it had been a massive stock with a deep furrow across it, and was then fractured along this furrow. The half which represents the specimen is thus a single ridge (the face of the old fracture is shaded in fig. 23 *b*, Pl. XIII.), and the ridge formation has appeared transversely along its top. Fig. 23 *a* shows the original outside of the stock.

a. Zool. Dept. 1904. 10. 17. 34.

54. **Porites Ellice Islands** $_{(17)}$**15.** (*P. Elliciana quintadecima.*) (Pl. VII. fig. 7.)

[Funafuti, 7 fathoms, coll. J. S. Gardiner; Cambridge University Museum.]

Description.—The corallum forms small, smooth, rounded mounds, with adherent edges and rapidly thickening centre. A colony 2·5 cm. in diameter is 0·75 cm. thick. Successive layers of these small mounds apparently build up a nodulated coral crust.

The calicles are about 1·2 mm. in diameter; circular, but without sharp outline and flush with the surface. The walls are irregularly thick, flat-topped, or slightly rounded; they consist

of a reticulum of a very variable texture, here finely filamentous with open meshes, there coarse and apparently built of thick, flat, spiky or nodulated flakes, but mostly with neat round pores. The septa can sometimes be traced into the reticulum on the top of the wall, but they usually begin in large echinulate wall-granules, not very clearly separated as granules either from the wall or from the small septal granules, which sometimes link them to the pali. The three granules when run together make a thick, tapering, echinulate septum. The ring of pali is complete but not conspicuous; the principals are irregularly echinulate. The fossa is small, the central tubercle large, and flattened in the directive plane. All the skeletal elements thicken very rapidly, and this thickening can be seen in a side view of the pali and other projections, and still better in vertical sections; the trabeculæ thicken below so as almost to obliterate the intervening spaces, and thus to form a nearly solid mass. This rapid solidification of the coral appears to be correlated with the shallowness of the calicles.

There is no other known *Porites* from the Ellice Islands group at all like this.

The small size of the stock and its irregularity suggest that it was struggling with unfavourable conditions; if so, we do not at all know *how* these have affected the calicle skeleton. But this of course is the standing difficulty, and makes all attempts at definitive systematic arrangement impossible until more work has been done on the reefs.

55. **Porites Ellice Islands** (17)**16.** (*P. Elliciana sextadecima.*) (Pl. VII. fig. 8; Pl. XIV. fig. 24.)

[Funafuti,* coll. W. J. Sollas; British Museum.]

Description.—The corallum rises as thin, crooked, nodulated stems, here rounded, there flattened, from 1·5 to 2 cm. thick. The complete height and the form of clustering are unknown. From the sides of the stem thin slightly compressed branchlets arise, and fork at about 2 cm. from the main stem. The living layer is at least 5·5 cm. deep.

The calicles are sub-circular, flush with the surface, 1 mm. in diameter. The walls are stout but simple near the tips, gradually thickening down the stem, becoming a reticulum so dense that where the mosaic of surface granules is rubbed off it looks as if built of solid flakes parallel with the surface. The septa are in complete formula and very regular, the top edge of each consisting of two large granular thickenings joined by narrow connections; these are the septal granules and the pali; the latter are either as in Diagram E or F (fig. 3, Introduction, p. 19). The ventral directive sometimes runs into the flattened tubercle, which is large and rises to the height of the pali. The tubercle and the pali are often joined by thin strands. The interseptal loculi are conspicuous and deep in the upper calicles (see Pl. VII. fig. 8), but much fainter round the lower parts, where the surface tends to become a close mosaic of granules arranged in regular circular patterns.

The section shows rather stout trabeculæ, the concentric elements being feebly but irregularly developed.

* See observation at head of Ellice Islands group.

The part of the stock photographed shows the mosaic rather broken up (? rubbed off); but other parts of the stock show the usual surface character of branching *Porites* with trabecular section—the tips of the trabeculæ form a compact mass of large granules at the surface in which the calicle patterns can be traced (cf. Pl. II. figs. 6, 7). The other calicle type in branching *Porites* is that shown, for instance, in Pl. II. fig. 8; the cross section consisting mainly of the concentric as opposed to the trabecular elements.

A worm-tube 0·75 mm. in the lowest section increases in size to 3·25 mm. in the section 4 cm. higher up. The worm and the coral must have grown up together.

a. Zool. Dept. 1904. 10. 17. 35.

56. **Porites Ellice Islands** $_{(17)}$**17.** (*P. Elliciana septimadecima.*) (Pl. VII. fig. 9; Pl. XIV. fig. 25.)

[Funafuti,* coll. W. J. Sollas; British Museum.]

Description.—The corallum forms irregular, flattened, spatulate knobs, some 3 to 3·5 cm. high, and about the same broad, and from 1·5 to 2 cm. thick. The edges, though rounded, thin away, and show indications of dividing into lobes. The neck shows slight constriction. The form and size of the base are quite unknown.

The calicles are 1 mm. in diameter, but look small and crowded; they are flush with the surface, and show no regular shape. The wall appears an irregular zigzag thread, here thinner, there broader and more flaky; where broadest, with large open pores. Here and there the large wall-flakes are smooth and solid-looking, but it may be that the surface has been rubbed, and the finer surface threads and frosted branching tips of the coral worn off. These can still be seen in rather more sheltered hollows, and the whole surface at such spots has a soft woolly or velvety appearance. The septa project from the wall threads, short and bent, but fusing in the typical way. They are only irregularly visible at the surface, whereas the pali are conspicuous (D and E, fig. 3, p. 19), surrounded very irregularly with septal granules, the latter being frequently joined to the wall.

Round the sharp edges of the knob there is a light open streaming network, apparently filamentous, in which calicles appear with large columellar tangle flush with the surface.

These two interesting fragments were originally of an ash-grey colour, but on treatment with eau-de-Javelle they turned a pale salmon-pink. The calicles are very difficult to describe. The contrast between the coarse stony appearance of the wall reticulum over a large part of the coral, and the frosted pali and septal granules within, seems to indicate that the walls themselves have been worn down, while the intra-calicular skeletons escaped injury by having been slightly sunk below the level of the surface. Fig. 9, Pl. VII., is taken from a part where the walls may have been rubbed down. At the same time, it is quite possible that this may be an adaptation to the smooth exposed surface, and that the woolly appearance caused by the rising up of fine skeletal points and filaments may be normal only in concave, and therefore

* See observation at head of Ellice Islands group.

protected portions of the surface. There is such a patch on the fragment on the right (see fig. 25, Pl. XIII.).

It is to be regretted that we have no knowledge of the kind of base from which these spatulate nodules arose. See the account of next form (No. 1904. 10. 17. 37).

a. Two fragments. Zool. Dept. 1904. 10. 17. 36.

In addition to the foregoing, there are two specimens from Funafuti, both collected and presented by Professor W. J. Sollas, which should be mentioned, but are hardly worth describing in detail.

The specimen registered No. 1904. 10. 17. 37 (Zool. Dept.), lay on its side as a detached stock. It was bean-shaped, and its rounded thicker side had been uppermost, and the thinner notched side undermost, and with the decayed stalk in the centre of the notch. The living layer was only alive in patches. The calicles are small, 1 mm., crowded, or slightly pitted. The walls are a thin zigzag thread, and the septa form in the typical manner.

It is impossible to miss seeing a general likeness between the calicles of this detached stock and those of the last form, but the skeletal elements seemed less neatly arranged, more finely granular, the granules being minute and frosted, giving a soft, woolly appearance to the surface.

It seems just possible that this detached bean-shaped coral, 5 cm. high, 6·5 cm. in length, and 4 cm. thick, may have been one of the spatulate knobs, broken off, and living as a free stock.

a. Zool. Dept. 1904. 10. 17. 37.

Specimen registered No. 1904. 10. 17. 38. (Zool. Dept.) is a decayed fragment of a massive *Porites*. Only worn and corroded surfaces are available for examination. The trabeculæ are thick and crowded, making the vertical section nearly solid. In the horizontal section the most conspicuous feature is the open reticulum of threads of varying thickness, swelling here and there almost into knobs. The walls seem to have been thin, and composed of these threads so arranged in a zigzag as to leave the interseptal loculi petaloid. The sections of the calicles are conspicuous as rosettes of such interseptal loculi, about 1·5 mm. in diameter.

Lastly, we must call attention to the record * of the collection made by Mr. C. Headley, of the Australian Museum, Sydney. Some seven distinct forms are noted, but, having no other method than that of all previous coral systematists, Mr. Whitelegge has to attribute them without detailed descriptions to so many of what are rashly called "known species." We have more or less adequate records of some of the forms which *Porites* assumes, and that is all, but I should hesitate before saying that any specimen I had was like any one of the earlier described forms. Several very interesting facts can, however, be gathered from Mr. Whitelegge's notes.

1. A form resembling the "*Porites lichen*" of Dana had calicles separated by ridges like those of *P. Society Islands 2*. This is a rare feature. The size of some of the calicles, 2·5 mm., suggests the presence of double calicles. See also No. 5, below.

2. A form resembling the *P. lutea* of M.-E. and H., the original of which was from Tongatabu, and is that preserved as No. Z 191*a* in the Paris Museum, which belonged to

* By Mr. Thomas Whitelegge, Memoirs, iii. part 6, Australian Museum (1898) p. 366.

the Quoy and Gaimard Collection. I have described this, though unfortunately without figures, on p. 34.

3. A form resembling the *Porites lobata* of Dana, which was from the Sandwich Islands, and with characters which are not at all clear from Dana's description. See below, p. 100.

4. A cœnenchymatous form resembling *P. Fiji Islands 5*.

5. Three specimens presumably characterised by great numbers of double calicles. This was made a specific character by Mr. Quelch, a 'Challenger' specimen being called on that account *Porites mirabilis*. We do not know what are the causes of these double calicles, but they are very common. Their presence in large numbers should, I think, be regarded more as a physiological accident than as a morphological character.

6. Two specimens said to resemble the coral called *Porites Gaimardi* by Milne-Edwards and Haime. This has been described on p. 90, from what appears to be the original specimen, preserved in the Paris Museum (Z 188*a*).

7. A cœnenchymatous form resembling the *Synaræa undulata* of Klunzinger. See below, *P. Red Sea 4*. This is certainly quite different from any of the forms here recorded in detail.

It is clear that none of the above forms, so inadequately recorded, can be utilised with any advantage in this work. It is greatly to be wished that any which are clearly different in kind from the seventeen apparently distinct forms above shown to occur at Funafuti should as soon as possible be fully described and adequately illustrated.

NEW HEBRIDES.

57. Porites New Hebrides (1)1. (*P. Nova Hebridiana prima.*) (Pl. VIII. fig. 1.)

[Api., coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites parvistellata* Quelch, Chall. Rep. xvi. (1886) p. 184, pl. xi. figs. 8, 8*a* (*non* Gardiner, see *P. Ellice Islands 10*, p. 73.)

Description.—The corallum rises into steeply convex almost ovate masses, the surface slightly convoluted with shallow sulci. The living layer extends 4–5 cm. downwards, with creeping edges closely adherent.

The calicles are small, under 1 mm., crowded, deep and angular, the walls are thin, tall, membranous, and irregularly porous; seen from above as smooth, stout, straight threads, but from the side with irregular denticulations. Here and there parts of an inner synapticular wall are developed. On the lower sides of the stock the walls may thicken and become reticular. The septa, which are thin and distinct, may commence to project from the top edge of the wall but they meet lower down to form the pali, only the four principals of which can be seen. Where the walls are thicker the pali may reach the level of the surface. The fossa is neatly circular and deep, but not conspicuous.

There are two specimens: one, *a*, rises almost symmetrically, mulberry-shaped, from a slightly constricted base of attachment; the other, *b*, has been distorted by having had to struggle with foreign organisms. The calicles in both cases are alike.

The deep calicles with steep membranous walls are interesting, and differentiate it entirely rom *P. Ellice Islands 10*, which Mr. Gardiner suggested might be a related form.

a, *b*. Zool. Dept. 86. 12. 9. 317–318.

QUEEN CHARLOTTE ISLANDS.

58. Porites Queen Charlotte Islands (1). (*P. Carlottæ prima.*)

[Vanikoro, coll. Quoy and Gaimard; ? Paris Museum.]

Syn. *Porites conglomerata* Quoy and Gaimard (*non* Esper), Voyage de l'Astrolabe, Zooph. iv. (1833) p. 249; Atlas, pl. xviii. figs. 6–8.
? Porites Gaimardi M.-E. & H., Les Coralliaires, iii. (1860) p. 179.

Description.—The corallum forms rounded masses. The specimen figured had the uppermost surface killed down, and the sides were expanding above a stalk-like neck.

The calicles are very small (?)* crowded, polygonal or very often hexagonal, not very deep, and with rough borders. Some of the pali rise to the level of the walls—the section shows a close network.

Each polyp is bordered with a beautiful reddish violet, the centre spotted with black.

We gather from the figures—for the original specimen appears to be lost—that the walls were thin and zigzag.

Referring to my notes, I find that there is a specimen (Z 188*a*) labelled "*P. Gaimardi*" Quoy and Gaimard, Vanikoro, 1829," but it is quite different from this, and as it has a still older label with "*Nouvelle Irlande, astrée en boule*" upon it, it is here described under the heading *P. New Ireland 1.* No. Z 188*b*, is also labelled "*P. Gaimardi*," but its locality is not recorded, and it is different from either of the above.

* "Extrêmement petites" ought hardly to be translated "very small," for we do not know what standard of comparison the authors were using. We can hardly believe that their standard was that supplied by a wide survey of members of this genus. The terms were quite as likely employed with reference to coral polyps in general.

SOLOMON ISLANDS.

59. **Porites Solomon Islands (10)1.** (*P. Salomonis prima.*) (Pl. IX. fig. 1.)

[Santa Anna Island,* coll. Dr. Guppy; British Museum.]

Description.—The corallum forms rounded knobs, with smooth surface, slightly and scantily convoluted. The method of attachment is not known; the sides creep down at least 4 cm.

The calicles, about 1·5 mm. across, are depressed and round, but not well defined owing to the loose flaky character of the reticular walls. The walls are 1 mm. thick, evenly round-topped, and consist of a very ragged reticulum showing a confused tangle of loose, rounded and pointed ends of skeletal matter. Its primitive structure out of trabeculæ, septa, and the inner synapticular ring, is not traceable. In the narrow valleys where the calicles are crowded and squeezed out of shape, the ragged walls may be thin and incomplete. The septa are also very ragged, but fairly symmetrically arranged; some seven or eight of them end in minute paliform granules, which form an indistinct ring around a circular fossa. This fossa is conspicuous to the naked eye. In its base is a small columellar tubercle.

At the sides of the stock the walls thicken and become more turgid, and the pali and septa more conspicuous.

The section shows a very loose trabecular texture, with large round pores between thin wavy trabeculæ. Tabulæ are very conspicuous.

There is only one specimen of this coral, which is like no other *Porites* in the collection. Its swollen walls, all reaching to the same height, and raising the whole surface except along a few narrow valleys, are peculiar features.

a. Zool. Dept. 84. 12. 11. 2.

60. **Porites Solomon Islands (10)2.** (*P. Salomonis secunda.*) (Pl. VIII. fig. 2.)

[Makira Harbour, San Cristoval, coll. H.M.S. 'Herald'; British Museum.]

Description.—The corallum is massive and closely encrusting, the surface nearly smooth, with faint swellings separated by shallow valleys.

Calicles shallow and round on the swellings, sharply angular in the valleys, mostly under 1 mm. The edges of the walls are composed of thin, nearly continuous rows of delicately frosted granules in the valleys, but on the swellings these rows rise as median ridges, on each side of which are broad, smooth, flat shelves diminishing in width as the swelling slopes into the valley. From these ridges, or from the edges of the shelves and apparently upon their surfaces, rise longer or shorter granules which represent the septa. Within each ring of granules there is

* The Island Santa Anna is at the extreme S.E. end of the group.

a rather deep fossa, from which pali with white frosted tips rise conspicuously to the level of the wall. The pali are thus separated from the septal granules by a slight circular trough, which is not conspicuous. The five principals are large and conspicuous (in the figure they are mostly rubbed off), and sometimes there is a minute dorsal directive added. There is no central tubercle.

The section of the coral shows a compact, singularly regular system of trabeculæ with close cross bars. The colour stain extends about 3·5 mm. below the surface. Tabulæ are excessively fine, and are not in continuous regular tiers, but broken up at all angles to the surface.

There is only one specimen of this coral, which has been broken in chipping it off some rounded or cylindrical surface to which it was adhering. It differs entirely from all other *Porites* from this locality. The great difference between the walls on the swellings and in the valleys recalls *Porites Ellice Islands 2* (Gardiner's '*superfusa*'); but the calicles are smaller, and the thickenings of the walls on the swellings are so obviously for the strengthening of the more exposed parts, whereas in '*P. superfusa*' the proliferation of the delicate reticulum which raises certain areas is apparently due to the stimulation of commensal worms, and has no resemblance to the hard, flat walls of this type.

a. (Presented by the Lords of the Admiralty.) Zool. Dept. 55. 12. 7. 152.

61. **Porites Solomon Islands** (10)**3.** (*P. Salomonis tertia.*) (Pl. VIII. fig. 9; Pl. XI. fig. 4.)

[Treasury Island, coll. Dr. Guppy; British Museum.]

Description.—The corallum forms small, elegant tufts of stems from 8–10 mm. thick. The branching is quite irregular; apparently wherever there is room small rounded knobs grow out, swell, flatten, and divide into two or three fresh knobs, which again swell. The living layer is from 3–3·5 cm. deep. The dying portion is covered with a thin, white, glistening epithecal film.

The calicles are uniform, superficial, 1 mm. in diameter, and angular. The wall traces a thin, ragged, often zigzag line like a network over the whole stock; it is sharp and slightly raised near the tips of the branches, but thicker and less well defined or raised on the lower parts. These wall lines are lost on the swollen tips, where a lamellated axial reticulum comes to the surface, making the swelling knobs look woolly. On these tips growing calicles with markedly lamellate septa can in some cases be clearly traced. The whole surface is granular, the granules being frosted; the walls are rows of granules sometimes joined by a very fine thread, at others resting singly upon a ring of flat flakes running round the calicle. Within this ring is that of the septal granules, and within this again the pali in formula D, fig. 3 (p. 19), except that the dorsal directive is thin and plate-like; a small columellar tubercle reaches to about the same level as the pali.

This coral differs both in growth-form and calicle structure from all the branching *Porites* in the collection.

a. Zool. Dept. 84. 11. 21. 25.

62. **Porites Solomon Islands (10)4.** (*P. Salomonis quarta.*) (Pl. IX. fig. 2; Pl. XI. fig. 5.)

[Treasury Island, coll. Dr. Guppy; British Museum.]

Description.—The corallum forms a tangled clump of branching and forking or short cockscomb-like processes, bent, fusing and radiating in all directions from a central encrusting base, which closely envelops the thick stems of other branching corals. The edges of its explanate encrusting base are often free and very sharp and thin, with a margin of epitheca projecting.

The calicles are not very crowded, 1 mm. in diameter, quite superficial, except where sunk between low cœnenchymatous ramparts; ill-defined and not very visible, as irregular star-like breaks in the surface. The walls are flat on all smooth explanate portions of the stock, and consist of large smooth flakes, but on the branches they are swollen into low rounded ramparts of close reticulum, the end threads of which look like granules, so that the whole coral has a kind of "bloom" over it. The septa are rather thick and well developed; the usual pairs meet and fuse so completely as only to leave six long interseptal loculi opening into the fossa. The pali are only slightly more differentiated than the other granules, and form no conspicuous compact ring visible to the naked eye. The fossa shows the usual dimorphism, being sometimes deep, dark punctures from which a few interseptal loculi radiate outwards, and at others closed by a dense almost plate-like columellar tangle on which there may be an inconspicuous tubercle. The section shows a light, very open reticulum, in which the trabecular and the horizontal or concentric elements are equally thin.

There is one complete stock encrusting the dead branches of a *Madrepora*. Two or three separate edges can be seen investing the supporting stem of the *Madrepora*, the innermost adhering to it, while the outermost creeps with many a free edge over the tips of the branches of former living layers, and in doing so shows a tendency to break up into small patches.

It is difficult to fix exactly what was the position of the coral when it was growing, but it looks as if the wavy irregular cockscomb-like processes grew outwards in almost vertical planes and very close together. They are about 1 cm. long, with their surfaces deeply indented by the calicles sunk between sloping cœnenchymatous ridges. Calicles occur in the more open reticulum right up to the growing angular tips of the branchlets.

This is the only cœnenchymatous *Porites* so far recorded from the Solomon Islands.

a. Zool. Dept. 84. 11. 21. 29.

63. **Porites Solomon Islands (10)5.** (*P. Salomonis quinta.*) (Pl. VIII. fig. 3; Pl. XIII. fig. 26.)

[Shortland Island, coll. Dr. Guppy; British Museum.]

Description.—The corallum forms large rounded masses with smooth, slightly wavy surface. The edges turn under all round, closely adherent.

Calicles minute, 0·75 mm., quite superficial, of no regular shape. The walls are thin,

wavy or zigzag threads (or porous plates) which do not rise above the surface. The narrow lamellate septa project sometimes quite from the margin, sometimes just below it, often angularly bent and with traces of an inner synapticular wall uniting them together, but they always rise up to the level of the wall. The pali are long thin rods tipped with minute pointed branches; one or two may be connected with the septa near the margin, but mostly the connection is some way down in the calicle. Formula D, fig. 3 (see Introduction, p. 19) seems most common. The central tubercle may be a thin flake. Between these thin membranous and filamentous elements of the skeleton one can see down (that is, everywhere it has been cleaned) into the depths of the coral, there being no conspicuous columellar tangle filling up the fossa.

There is one large, smooth, rounded mass 12–13 cm. high and 15 in longest diameter. The mass growing on a narrow base appears to have rolled on to its side, as shown in Pl. XIII. fig. 26.

This specimen was labelled by Mr. Ridley *Porites tenuis* (see *P. China Sea 1*). But Dr. Verrill's original description of *P. tenuis* is too general and might apply to almost any glomerate *Porites*. The localities, also, are so far apart that the chances of the two forms being specifically identical are very small indeed. The uniformity in thickness of the thin membranous wall- and septal-edges, the character of the pali, coupled with the small sizes of the calicles, the scantiness of the columellar tangle (so that one can see deep down the open interseptal loculi, which do not seem to close up by any apparent thickening of the skeletal elements) are the chief features of this coral. The surface is very smooth to the touch, and the dried coral is a dull fawn colour.

a. Zool. Dept. 84. 12. 11. 11.

64. **Porites Solomon Islands** $_{(10)}$**6**. (*P. Salomonis sexta.*) (Pl. VIII. figs. 5, 6.)

[Shortland Island, coll. Dr. Guppy; British Museum.]

Description.—The corallum forms great solid masses, which envelop the tips of stout branching corals. Its surface, otherwise smooth, is much broken up into a confused system of ridges with slight keels along their top, and sharp, narrow, intervening valleys. The edge of the living layer is closely adherent, and creeps under into crevices and holes.

The calicles are shallow, very angular, very variable in size, up to 1·25 mm. The walls are low and straight, composed of either threads or rows of granules beset with blunt points; seen sideways, they are very porous and fragile, the edge granules being the flattened tips of trabeculæ. Within the wall, or some way below its edges, there are frequent traces of an inner synapticular wall, which is here symmetrical and regular, there melted down with the wall into a fragile flaky reticulum. The septa are lamellate, porous, delicate, crisp, slightly bent, and beset with blunt points and angles. Owing to the irregularity of the inner synapticular wall, the septa often seem to fork near the wall, but the formula is that of *Porites*. The pali are lamellate plates, rising together like a conspicuous boss from the centre of the calicle nearly as high as the walls, the four principals often V-shaped. The tips are very slightly

swollen; except for that, the formula is that of G, fig. 3 (see Introduction, p. 19), the directives often running nearly across the calicle, involving the flattened central tubercle, and forming the trident with the vertical secondaries. Below the surface a conspicuous columellar tangle is visible.

The calicles on some of the creeping edges low down are of a very different type. They are flush with the surface, which is a mosaic of crisp echinulate granules, in which the thick walls may be traced, and the calicles are recognised by the radial interseptal loculi and the concentric furrows between the wall- and the septal granules, and between these latter and the pali. (See Pl. VIII. fig. 6.)

There is again only one specimen. Though it is of the same colour as the two preceding forms, the differences in the structure of the calicles, as shown in the photographs, are so great that it is necessary to describe them separately. The calicles are not unlike those of *P. Tonga Islands 6*, but the resemblance is superficial. In this form pali stand up as a ring, visible to the naked eye from the shallow floor for the calicle. The convolutions of the surface are interesting. The specimen is not quite complete, but there is reason to believe that it forms, as stated above, a heavy knob upon the tips of the branches of other corals.

a. Zool. Dept. 84. 12. 11. 13.

65. **Porites Solomon Islands 7.** (*P. Salomonis septima.*) (Pl. VIII. fig. 4; Pl. XIII. fig. 27.)

[Choiseul Bay, coll. Dr. Guppy; British Museum.]

Description.—The corallum forms thick inverted pyramids, with smooth, nearly level top and rounded edges, and steep sides slanting inwards towards the base. The living layer is mainly confined to the upper surface, extending irregularly down the sides for from 1 to 3 cm

The calicles are small, 1 mm., deep and angular. Walls finely membranous, raised uniformly over the whole surface, only occasionally fenestrated, with ragged or denticulate edges, and with hardly any traces of septa appearing until some little way down below the fine edge. The first beginnings of the septa are small narrow-necked granules, putting out lateral synapticulæ for the formation of an inner wall-ring; lower down they project far enough to form a fine palic ring round the fossa which joins the pali together, and is present in most calicles, though never quite complete. The pali, of which the four principals are often alone conspicuous, are tall, thin rods. The components of the ventral triplet often form a trident with a portion of the columellar ring. See formula G, fig. 3 (Introduction, p. 19). The columellar tubercle is small and granular, and attached to the ring supporting the pali by three to four spokes, one of which is at times in a line with the directive septa. A continuous directive line right across is seldom if ever seen. The interseptal loculi are deep, open and conspicuous, and either run into the fossa or are cut short by the formation of the columellar ring above described as joining the pali.

The method of growth of this coral is very regular and typical. The epithecal bands, which might be expected round the sides as growth-period follows growth-period, are not seen, because the edges bend and creep down the sides. (See remarks and Diagram A, fig. 2, p. 24, Introduction, Vol. IV.) The membranous walls, here sharply exsert, are interesting. The specimen was labelled "*P. parvistellata* Quelch" by Mr. Ridley (see *P. New Hebrides 1* p. 81); but the calicles are much larger than in that type, and the walls are much taller and more uniformly membranous, and the method of growth is different.

a. Zool. Dept. 84. 12. 11. 12.

66. **Porites Solomon Islands** $_{(10)}$**8**. (*P. Salomonis octava.*) (Pl. VIII. fig. 7; Pl. XIII. fig. 28.)

[Choiseul Bay, coll. Dr. Guppy; British Museum.]

Description.—The corallum rises into low, irregularly compressed columns or ovals, with swollen, rounded tops. The living layer, which is about 4 cm. deep, dies progressively, and appears to be covered by a thin, epithecal pellicle, which corrodes away.

The calicles are deep and polygonal at the top, but get shallower and rounder down the sides, about 1·5 mm. across. The walls are pronounced, thick and high, and form together a very striking network covering the surface. On the growing top they have a thin, ragged, trabecular edge; lower down they are crisp and reticular, and the origin of the reticulum out of intervening trabeculæ, though obscured, is traceable. The septa are symmetrical, lamellate, very thin and short, so as to leave an open, deep, and conspicuous fossa, in the base of which is a delicate, open columellar tangle. The typical fusion of the septa can only occasionally be traced, low down, where they join the columellar tangle. Young polyps appear in the tops of the walls in the angles. No distinct rings of pali appear in these calicles on the growing top of the stock. Down the sides, the skeleton everywhere gradually thickens, the calicles become shallow, and pali gradually appear, ultimately becoming very prominent, with a lamellate columellar tubercle. These pali reach almost to the height of the thick walls, from the tops of which twelve thick wedge-shaped septa closely packed descend slantingly. The granulation of the walls is very marked, the grains being large and close, like the teeth of a file.

This coral has all the usual characteristics of a *Goniopora*. The deep angular young calicles with lamellate septa and without pali on the top of the coral, while at its sides the walls gradually thicken, and the calicles get shallower and the pali more and more prominent, until in the shallowest calicles just before they die down they form the well-known rosette of pali, are characters which can be found in any *Goniopora* or in any *Porites*. The specimen was labelled "*Porites Gaimardi* M.-E. & H.," but that "species" had shallow calicles with prominent, rough septa and conspicuous round pali, according to the original description and figures of Quoy and Gaimard. We have, then, in this case a specimen which might belong either to *Porites* or *Goniopora*. It

is here placed with the former solely because it has only twelve septa, with no trace whatever of a third cycle, although the interseptal loculi are large enough to admit of rudimentary septa in their bases, had any been developed. On the absence of pali in *Porites* with deeper calicles, see Introduction, p. 18.

a. Zool. Dept. 84. 12. 11. 1.

67. **Porites Solomon Islands** $_{(10)}$**9.** (*P. Salomonis nona.*) (Pl. VIII. fig. 8; Pl. XII. fig. 1.)

[Solomon Islands, coll. Dr. Guppy; British Museum.]

Description.—The corallum rises into long, stout, tapering spikes, which branch seldom, but very irregularly and crookedly. The rounded stems at their bases where they are dying away may be 3 cm. thick. The spikes may be 12 cm. long, the rounded tips less than 0·5 cm. thick.

The calicles are flush with the surface, usually round, and 1 mm. in diameter. The walls are uniformly thick, flat and solid looking, and consist mostly of a mosaic of granules without definite order (these are here and there flattened into crumpled flakes). The intra-calicular skeleton is separated from the walls by a sharp furrow. The ring of septal granules is frequently complete and symmetrical, the granules themselves being very small. Within this ring are the pali in the complete formula of eight (B, fig. 3, Introduction, p. 19). A columellar tubercle fills up the centre.

The cross section shows trabecular and concentric elements, both thick, both equally and very symmetrically developed.

There are three large specimens of this coral. As might be expected, they were labelled "*P. levis* Dana" (see *P. Fiji Islands 1*). There is, however, no special resemblance to Dana's coral in growth-form: the tips are not compressed, and the surface granules not so large and massive, and the relative sizes of trabecular and concentric elements more nearly equal and both symmetrically arranged. In *P. Fiji Islands 1* the trabecular elements are thicker than the concentric, a fact which may be co-ordinated with the larger size of the surface granules, and the arrangement is not very regular.

Most of the stems and branches of the specimen were in life being hollowed out by a boring sponge, whose oscula may be found within even 0·5 cm. of their extreme points.

a, b, c. Zool. Dept. 84. 11. 21. {23. 24. 33.

68. **Porites Solomon Islands** $_{(10)}$**10.** (*P. Salomonis decima.*)

[Kaiserin Augusta Bay, Bougainville, coll. German Corvette 'Gazelle'; Berlin Museum.]

Syn. *Porites fragosa* Studer (? Dana), MB. Akad. Wiss. Berlin (1878) p. 537.

Description.—The corallum is shaped like a head, with wavy or humpy (*höckerige*) surface; occasionally, owing to growth in height accompanied by the dying away of the basal parts, it assumes strange shapes (e.g. like the fungus *Morchella*).

This is the essential part of Dr. Studer's description. Nothing is gained by claiming this to be of the same species as Dana's coral, *P. fragosa*, from the Fiji Islands (see p. 52). It is quite possible that many of these different forms, *could they be cultivated*, would turn out to be but variations due to the environment on some common form—variations, I mean, so unstable that transplantation would cause almost instant change. But that is exactly what we want to find out. The first step is to catalogue the forms themselves as they exist, making no assumptions as to their exact relationships.

The specimen which suggested the Morel fungus to Professor Studer had a cylindrical stalk 8–9 cm. thick and 18 cm. long. The head was alive; its surface was raised into a number of eminences, and its lower margin round the stalk had a very prominent edge.

NEW IRELAND.

69. **Porites New Ireland** (1)**1.** (*P. Nova Hibernica prima.*)

[New Ireland, coll. Quoy and Gaimard; Paris Museum.]

Syn. *Porites Gaimardi* (*partim*) M.-E. & H., Les Coralliaires, iii. (1860) p. 179.

Description.—The corallum is nearly hemispherical, with quite smooth surface.

The calicles, 1 mm. in diameter, are conspicuous and cylindrical, as if sharply sunk, from 0·5–0·75 mm. deep. The walls are uniformly 0·5 mm. across, with faint traces of a median thread, and thickened by the septa. The angles are reticular, and in almost every angle on the upper surface a minute shallow calicle is opening.

The septa are indistinct, thick, and closely packed. Some distance down they join a columellar tangle, which supports a star-shaped mass carrying the columellar tubercle. The pali form a neat conspicuous ring close to the wall of each calicle. The formula is irregular, owing to the fact that the typical fusions are sometimes not completed; nine pali may appear. The calicles seem to be distinguished by two rings of pores: outside the pali, the interseptal loculi; and inside, the spaces between the rays of the star-shaped central mass.

I do not feel satisfied about this description, taken from notes made in Paris six years ago, before any real insight into the genus was obtained.

The description is founded upon a specimen in that museum (No. Z 188*a*), which is one of Milne-Edwards' *P. Gaimardi*, with an old label "Nouvelle Irlande," and this is one of the localities mentioned by M.-E. & H. (l. c.). But this cannot, of course, be Quoy and Gaimard's type of their "*conglomerata*," which came from Vanikoro (see *P. Queen Charlotte Island 1*, p. 82), and the descriptions certainly do not agree. I find in my notes that the specimen is very beautiful in texture.

There were other specimens in the Paris Museum, labelled *P. Gaimardi*, but without localities, and none of them were like either this, or Quoy and Gaimard's description.

NEW GUINEA.

70. Porites New Guinea (3)1. (*P. Nova Guineensis 1.*)

[Galewo Straits, coll. German Corvette 'Gazelle'; Berlin Museum.]

Syn. *Synarœa convexa* Studer (? Verrill) MB. Akad. Wiss., Berlin (1878) p. 537.

Description.—The corallum forms large masses, 31 cm. high and 40 cm. in diameter. They are built up of more or less cylindrical branches of very varying thickness, and mostly end in cylindrical branchlets which are seldom flattened at the tips. The cœnenchyma is very open, loose, and reticular. The surface is covered with fine echinulæ.

The calicles have ill-defined outlines.

This is Dr. Studer's description. We gather from it that the coral was a cœnenchymatous *Porites*, resembling *P. Society Islands 3* in the structure of the calicles. The growth-forms of the two, however, seem to be very different, judging from the specimens of the latter in this museum.

71. Porites New Guinea (3)2. (*P. Nova Guineensis secunda.*) (Pl. IX. fig. 3.)

[New Guinea, coll. Macfarlane; British Museum.]

Description.—The corallum envelops other objects, either the tips of branched corals, and is then pear-shaped, or loose objects, and is then a free detached stock. The surface is smooth and slightly wavy. In the erect pear-shaped stock the living layer may extend downwards 10 cm., the edge being closely adherent round the base.

The calicles are minute, under 1 mm. in diameter, closely crowded, almost flush with the surface, and constructed of the finest filamentous reticulum, angular and crisp rather than fluent. The walls at the sides are a very delicate thread, slightly raised and in a fine zigzag, with, however, rounded angles. All over the coral there is a tendency to thicken this wall by an inner synapticular ring, the symmetry of which is never quite lost, and yet the reticular walls thus formed are not stiff. The septa are thin and angular, but they meet and form inconspicuous pali, the formula of which varies greatly, the four principals always being the largest. The fossa seems to be filled up with a close filamentous tangle.

There are two specimens: one pear-shaped, the stalk being a dead coral branch; and the other a free nodule. The surface is so delicate and friable that it is not always easy to say at any point whether the characters seen are those of the calicles at the surface, or those of a section formed by rubbing the surface down. Where the walls are crisp raised threads, there is no difficulty, but where the surface, as near the top of the pear-shaped stock, is a close

reticulum in which the outlines of the calicles alone can be traced, it is difficult to say whether this is artificial or natural. In the latter case the reticular surface might be compared with that which occurs on the tops of that method of growth, which in Vol. IV. on *Goniopora*, I have called the expanding-sheaf formation, and which seems also to occur here (see Introduction, p. 22).

It is to be regretted that there is no record as to what part of New Guinea these specimens came from. There is only one other *Porites* in the National Collection from this locality, and it is very different from this.

a. Pear-shaped stock. Zool. Dept. 87. 1. 29. 6.
b. Detached nodule. Zool. Dept. 87. 1. 29. 7.

72. **Porites New Guinea (3)3.** (*P. Nova Guineensis tertia.*) (Pl. IX. fig. 4.)

[New Guinea, coll. W. Gill; British Museum.]

Description.—The corallum is a small, oval, flattened pebble, without any attachment.

The calicles are 1–1·5 mm. in diameter, and funnel-shaped; they appear deepest round the rim of the oval. The wall is reticular, with an interrupted thread-like ridge from which coarse, thick septa slope symmetrically down towards the fossa. Where the surface seems to have been worn this thread is thick, smooth and zigzag, with the thick bases of the septa branching from it. The septa are thick at the base, wedge-shaped, and end in a group of minute frosted granules which seem to occupy the whole base. These granules are resolvable into septal granules, pali, and columellar tubercle. But the pali do not rise to break the downward slope of the septal edges; only in the calicles round the rim do the pali tend to stand up at all. The septal edges may be rows of the frosted granules, or else continuous, wedge-shaped plates with jagged edges. The interseptal loculi are thin, irregular slits, radiating symmetrically and reaching to the wall.

There is only one specimen of this coral, 3·8 cm. long, 2·8 cm. broad, and 1·7 cm. thick. Only one small patch about 1 cm. across was dead and corroded when the coral was found. The specimen may have been a natural development of some form which settles on small free objects, or a broken off nodule from some stationary coral. The former is suggested by its symmetrical shape without signs of its pebble form being due at all to attrition, for the surface is quite crisp. Unfortunately there are no other forms from New Guinea in the National Collection which might suggest a clue. In the meantime, then, it must be described by itself. It was labelled *P. Esperi*, which is the name Dr. Brüggemann proposed for Esper's second figure of *M. conglomerata*, a coral without locality, and now quite impossible to identify.

a. Zool. Dept. 77. 1. 31. 3.

PELEW ISLANDS.

73. Porites Pelew Islands (1)1. (*P. Palauensis prima.*)

[Pelew Islands; Hamburg Museum.]

Syn. *Porites capricornis* Rehberg, Abh. Naturw. Ver. Hamb., xii. (1892) p. 46, pl. iii. fig. 7.

Description.—The corallum forms a somewhat close tuft of long, tapering, occasionally fusing stems ("like goat- or antelope-horns"), but branching. The basal stems are as much as 6 cm. thick. It forms large colonies 30 cm. high. The tips are blunt and rounded off.

The calicles are mostly superficial, but some are slightly sunk; they are sub-polygonal. The walls are of an open meshwork ("breit gegittert"); the ring of pali usually distinct. The septa is somewhat irregular and unequal, "confusedly trabecular." The columella is hardly recognisable.

This coral from the Pelew Islands was of a deep black colour, and is compared by the author with *P. nigrescens* of Dana and *P. columnaris* Klunz., but its growth distinguishes it from either.

Dr. Rehberg's description of the calicle is hardly sufficient, but the growth-form is clearly very remarkable. The nearest coral to this in the National Collection is *P. Java Sea 2* from Billiton, but the calicles from this type are so peculiar that there can be no hesitation as to the necessity of keeping them apart. It is worth while, also, to compare the growth-form and black colour with that of a *Porites* shown in Esper's Pflanzenth. i., pl. xxi. *a*, as *Madrepora Porites*, from the East Indian Seas. Its branches are blunter and not so sinuous.

Other *Porites* recorded from the Pelew Islands, but not described, are:—

(1) A form in the Hamburg Museum, said to be of the same species as Dana's "*Porites nigrescens.*" See Rehberg (Abh. Naturw. Ver. Hamburg, xii. (1892) p. 47.)

(2) A specimen in the Strasburg Museum, identified by Ortmann (Zool. Jahrb. iii. Syst. (1888), p. 143) as of the same species as that called *Porites lutea* by Dr. Klunzinger. This name "*lutea*" has been applied very recklessly.

CAROLINE ISLANDS.

74. Porites Caroline Islands (4)1. (*P. Carolina prima.*)

[Ponapé, coll. Museum Godeffroy; ?]

Syn. *Porites decipiens* Brüggemann, Journ. Mus. Godeffroy, v. (1879) p. 210.

Description.—The corallum forms very compact clusters of dichotomously branching stems, which all reach to the same height, so that the upper surface is level or slightly convex. The

branchlets are thin, cylindrical, and swollen at the tips, which are blunt and angular. The larger stems are about 1 cm. thick.

The calicles are 1·3 mm. in diameter, very shallow everywhere, and quite superficial near the bases of the stems. The walls, where they rise at all above the surface, are thin ridges. The septa are very thin and obscure, the pali being still less clear, but, though not prominent, some six to eight are traceable. Both septa and pali are more pronounced in the lateral calicles. The fossa is moderately deep, with an occasional minute central tubercle.

The above is the essence of Brüggemann's description. The observations which follow it were written obviously in the belief that branching *Porites* are very rare. The claim that the nearest related form is the branching *P. conglomerata* of Esper will not hold, for that coral, as already noted, was a *Goniopora* (see p. 3).

Whether the *Porites* in the Hamburg Museum from the Union Islands mentioned by Rehberg (see above, p. 32) is the same form is very doubtful; it may be remarked that Brüggemann did not himself compare his coral with Dana's *P. cylindrica*.

A *Porites* from Samoa said to be like this coral is in the Museum at Bern (see p. 33).

75. **Porites Caroline Islands** $_{(4)}$**2.** (*P. Carolina secunda.*)

[Ponapé, coll. Museum Godeffroy; ?]

Syn. *Porites tumida* Brüggemann, Journ. Mus. Godeffroy, v. (1879) p. 211.

Description.—The corallum forms a dense cluster of stems rising from a small base. The stems are very crowded and fused below, only forking very irregularly and incompletely. In their upward growth they are alternately greatly swollen and then constricted; for the most part they give off short, rounded, almost globular twigs. The uppermost branchlets are either swollen and blunt, or else slightly tapered (this variation in the form of the twigs is to be correlated with the alternate swellings and constrictions of the stems). Stocks may rise to a height of 20 cm. and more.

The calicles are slightly over 1 mm. in diameter, uniform in size, and polygonal. The walls are raised as thin sharp ridges. The septa are thin, and appear from the description to form the typical formula. Six narrow pointed pali are fairly prominent. The fossa is deep, and the central tubercle is always present, but somewhat deep down.

This is the essence of the original description, and, as its author stated, the singular growth-form of the specimen (cf. *P. Mauritius 4* and *North Australia 6*), should make it easy to re-discover, when the same region is explored for the purpose.

76. **Porites Caroline Islands** $_{(4)}$**3.** (*P. Carolina tertia.*) (Pl. IX. fig. 5; Pl. XII. figs. 1, 2, 3.]

[Ponapé, coll. Mus. Godeffroy (?); British Museum.]

Description.—The corallum rises into thick, irregular, flame-like columns from an encrusting base, which dies away and completely disappears in older stocks, although there is

a tendency for free explanate edges, which sometimes curl upwards to reappear. These free edges are 1 mm. thick. The columns are bent and ragged, but thick and fusing irregularly together. The living layer extends from 6–15 cm. deep. The whole rising surface is covered with soft looking cœnenchymatous papillæ and ridges, which are thin, 1–1·5 mm. across and 1 mm. high, slightly swollen and round-topped, and though gyrating, tend mostly to run upwards in the direction of growth. These cœnenchymatous uprisings are best developed near the tips of the flaming-columns.

The calicles are small, 0·75 mm. across; they run in streams between the papillate ridges, but they are conspicuous owing to their neat compact rings of pali. These surround a minute pin-hole fossa. The walls are level with the surface, and except where swollen into papillæ they are smooth and flat. The distance between the calicles varies greatly, the intervening spaces being a mosaic of frosted granules. Round each calicle there is a ring of thick, short septal granules continuous with those on the tops of the walls. The rings of pali are separated from the septal granules by shallow ill-defined circular troughs. They consist of the five principals and the dorsal directive; the triplets are often irregular, and all but the dorsal directive are thick and frosted, the four principals being often bluntly V-shaped. The fossa is either a deep open pin-hole, or else is closed by a columellar tubercle which, like the pali and surface granules, has no sharp outline, and does not rise to the level of the ring of pali.

The rich covering of surface granules makes the bleached coral look soft and of a creamy white colour.

The irregular flame-like growths due to the formation of cœnenchymatous ridges are very interesting features in this genus. The specimens came from Ponapé, where also one of the most beautiful developments of papillate Montipores ("*M. prolifera*") is found. It is worth noting that even in this case, which is one of the most pronounced of the cœnenchymatous *Porites*, the epitheca follows the growing edges right to their extreme limits. This is seldom the case in *Montipora* (see Introduction, p. 22). The specimens were labelled originally *Synaræa monticulosa*, but see Introduction on the generic name *Synaræa* and p. 54 for the description of Dana's type.

The chief specimen, *a*, is that figured in Pl. XII. fig. 1. With it I have associated a smaller fragment, *b* (fig. 2), which has a large horizontal free edge curling out from the lower edge of the living layer. This latter was encrusting a thick, smooth columnar growth, which, from study of the sections, seems to have been a dead portion of the same coral. If so, its surface papillæ must have been either submerged by growth in thickness or else corroded off after death.

a. Zool. Dept. 81. 11. 21. 7.
b. (Locality not certain.) Zool. Dept. 1904. 10. 17. 39.

There are two other specimens, but they also, like *b*, have no recorded locality which can be trusted: but, in spite of differences, they seem to be only slight variations on the above, and as they were both obtained from the collection of Mr. John Morgan, who purchased part of the corals of the Museum Godeffroy, they are here all grouped together.

The corallum has the same methods of growth as *a*, but the surface is a smooth, close reticulum without granules, and the cœnenchymatous upheavals are not round and swollen, but conical and sharp, forming pointed and crested tips to the flames. There are consequently no septal granules, and no conspicuous pali, and the septal skeleton is quite visible, being flush

with the surface. The septa meet and fuse in the typical manner; but inasmuch as they meet the columellar ring, the triplet is a little obscure. From the points of fusion pali of irregular sizes appear. A smooth, solid columellar tubercle here and there rises in the otherwise open and deep pin-hole fossa. There is no circular trough marking out the calicles, which here appear merely as darker and more open spots in the reticulum, and the coral, instead of the soft creamy appearance, has a bluish-grey stony look.

One of these specimens has the upright columellar method of growth of *a*; but the other (Pl. XII. fig. 3) seems, at an earlier stage, to have been overturned, and from all its surface short, thick, flame-like columns have sprung up, which bend about and fuse quite irregularly.

Among these secondary outgrowths many new stocks have started and show explanate bases with free edges. If there is plenty of room, the base may expand smoothly for a considerable extent before rising into cœnenchymatous flames. If there is little room, the surface rises at once.

c, d. Zool. Dept. 99. 3. 2. 6 and 7.

77. **Porites Caroline Islands** $_{(4)}$**4.** (*P. Carolina quarta*). (Pl. IX. fig. 7; Pl. XII. fig. 4.)

[Ponapé, coll. Mus. Godeffroy; British Museum.]

Description.—The corallum forms a large oval mass standing on a small base. On the upper half the surface rises into sub-conical lobes, which here and there run together to form wavy and rather sharp ridges. In the valleys between these lobes the surface dies. The living layer is some 12 cm. deep, and has a tendency to hang free, even here and there to bend outwards round the base, which is built up by the edges of former growths. Similar pendent or curling edges are seen trying to dip down into the valleys between the lobes, in which valleys the surface has died.

The calicles are 1 mm. across, and are deeply sunk in all the upper parts of the stock between high walls, which are either a thin trabecular latticework or thick and reticular. They are irregularly spaced, but nearly always isolated, seldom in meandrine groups. The walls are ragged rather than regularly denticulate, and rise to varying heights above the calicles at the top of the stock. At the angles the walls generally rise to a point. Young calicles developing on the tops of the walls start new lobes. The intra-calicular skeleton is very symmetrical with twelve deep interseptal loculi, which are open and conspicuous in the younger calicles, with their smooth skeleton, clear, open, columellar ring and tangle, with the seven to eight pali and central tubercle, which is smooth and slender. Where the skeleton is frosted, as in the adult calicle, the septa become wedge-shaped rows of large granules, and, with the large frosted pali, nearly fill the calicle, while the walls get gradually lower and more solid, and with smooth rounded surface.

The palic formula is complete. The three small pali of the ventral triplet do not break the palic ring, and are, therefore, not septal granules. The columellar tubercle is conspicuous, slightly flattened, and at a lower level than the pali. The columellar tangle is open, and the synapticulæ joining the pali are frequently high up and conspicuous.

There is one large specimen of this coral some 18 cm. high and 14 cm. across. Many free edges have been produced. The earliest stock, which can be seen, is still embedded in the base, and is a convex mass 3 cm. in diameter. Above this, repeated growth-periods, with edges tending to be free, have built up the present stock. The specimen is much infested by calcareous worm-tubes, while openings for the syphons of molluscs, and large fissures where crabs lurked, are numerous. These latter are generally bordered by a free thin edge of coral, supported and protected by epitheca, as if the coral endeavoured to arch over and thus close the apertures.

a. Zool. Dept. 81. 11. 21. 13.

The existence of a massive *Porites* from Ponapé is merely recorded by Brüggemann,* but without any description. The naming of it *Porites conglomerata* Quoy and Gaimard is quite in accordance with prevailing custom, but in such an intricate genus as *Porites* this is quite useless. In a simpler genus such a practice might suffice to suggest some fairly close resemblance to the figures and description of the form which originally received the name, but my experience shows that in this genus this is seldom if ever the case.

LAYSAN.

78. Porites Laysan (3)1. (*P. Laysana prima.*)

[Laysan, coll. Dr. Schauinsland; ? Bern Museum.]

Syn. *Porites lanuginosa* Studer, Zool. Jahrb. xiv. (Syst.) (1901) p. 423, pl. xxix. fig. 9.

Description.—The corallum is massive, nearly regularly rounded, but with its basal surface flattened. The stock is attached by the centre of the base to other corals, which it thus overhangs. The surface is broken up into a great number of comparatively smooth rounded humps from 2 cm. high to 2·7 cm. across, and separated by narrow and shallow valleys. The lower edges are closely adherent, and creep under the base to the point of attachment.

The calicles are about 1 mm. in diameter, a little larger on the eminences than in the valleys. The walls are a very open reticulum, fraying out along the top ridges in rough echinulations; these give the surface a woolly appearance. The septa have conspicuous edges, and are echinulate; some fuse together, and others join a columellar ring. There are six pali visible to the naked eye, and a central columellar tubercle.

Professor Studer calls attention to the "*P. porosa*" of Verrill from La Paz, Gulf of California, as possibly resembling this coral. But without figures it is very difficult to say exactly what the Californian coral was like (see *P. Gulf of California 2*, p. 107).

* Journ. Mus. Godeffroy v. (1879) p. 211.

79. **Porites Laysan** (3)**2.** (*P. Laysana secunda.*)

[Laysan, coll. Dr. Schauinsland; Bern Museum.]

Syn. *Porites Schauinslandi* Studer, Zool. Jahrb. xiv. (Syst.) (1901) p. 424, pl. xxx. fig. 22.

Description.—The corallum is encrusting, forming thick convex sheets with uneven upper surface, and edges rolled under. These edges are 1 mm. thick, supported by epitheca, and appear one above another. The thickness of the stock may be 1·5 cm.

The calicles are large, from 1·3–1·5 mm. in diameter, and hexagonal. The walls are very uniform, thinning to a median ridge of square-topped flattened trabeculæ, here and there united into plates, and arranged either in a straight row or in a zigzag.

The septa slope deeply down round the large open fossa, with toothed edges and slightly roughened sides. A rudimentary "columella" (? tubercle) rises in the floor of the fossa, surrounded by three to six small pali.

Double calicles appear, and sometimes rows of twos and threes, with only rudimentary walls between them.

This description is based upon Professor Studer's text and figures. The *Porites* is one of those in which the septa appear to remain apart, only showing slight traces of fusion and of pali formation deep down in the calicle (see Introduction, p. 18).

80. **Porites Laysan** (3)**3.** (*P. Laysana tertia.*)

[Laysan, coll. Dr. Schauinsland; Bern Museum.]

Syn. *Porites discoidea* Studer, Zool. Jahrb. xiv. (Syst.) (1901) p. 425, pl. xxxi. fig. 16.

Description.—The corallum is thin, 3 mm., and explanate. Surface smooth, except where distorted by foreign organisms (e.g. Serpula tubes). It rests upon and creeps over the dead surface of previous growths. The edges are very thin and sharp, with an advancing epitheca visible from above; the edge may be turned up.

The calicles are small, 1 mm. in diameter, and shallow. The walls are thin, zigzag and loosely trabecular, with the edges running out into irregular ("verzweigte") points. The septa project but a short way into the fossa, of open texture and with echinulate edges and sides. They fuse in the typical manner. The septa are connected directly with the trabecular walls. The pali reach nearly to the level of the walls. There is a central tubercle.

Professor Studer's excellent collotype figures of this and the foregoing corals, while they give the growth-form and general characters of the surface and calicles, do not show exact structural details of the calicles themselves. It was in order to show these that it has been found necessary in this Catalogue to give magnifications of the calicles.

SANDWICH ISLANDS.

81. Porites Sandwich Islands (9)1. (*P. Hawaiensis prima.*)

[Sandwich Islands, coll. Wilkes Expedition, 1838–42; ?]

Syn. *Porites mordax* Dana, Zooph. (1848) p. 552, pl. liii. figs. 3, 3*a*.
P. mordax var. *elongata*, ibid. fig. 4.

Description.—The corallum forms open clusters of stout, nearly erect branches. The clusters may be 25 cm. across and 20 cm. high. The branches are slightly compressed, under 1 cm. thick and from 1 to 2·5 cm. broad, fused at the bases into stout plates or cavernous masses, but free for from 4 to 5 cm. The living layer extends downwards 9 to 10 cm. The cluster thickens as it rises. Some specimens are massive and sub-lamellar, with obtuse lobes above instead of branches.

The calicles are large, 1·5 mm. deep and funnel-shaped; the walls are thin, sharp, and granular; the septa are sharp, thin, scabrous; the columellar tangle and tubercle are distinct. There is a somewhat inconspicuous ring of pali.

Judging from Dana's text and figures, from which the above is compiled, there can be little doubt that the calicles are very like those of some of the other Sandwich Islands *Porites* which are in the Museum, e.g. Nos. 5 and 6. They all have a certain roughness of texture. In this case the roughness seems to have been increased by an upgrowth of the wall-reticulum in the angles, such as is seen to some extent in No. 6, only there the young calicles develop in these upgrowths. This is the interpretation which I put upon Dana's description. There is, however, a specimen in the Paris Museum (No. Z, 192*a*) labelled *P. mordax*, Sandwich Islands, showing the walls raised into sharp ridges, somewhat like the cœnenchymatous ridges in *P. Society Islands 2*, the *P. latistellata* of Quelch from Tahiti. If this specimen is correctly identified, Dana's words "angles prominent" should have been "wall ridges prominent." Dana's figure of an enlarged calicle hardly leads one to expect such a specialisation, and there are no other specimens in the British Museum from the Sandwich Islands showing such ridge formation.

Dana's variety *elongata* ought, perhaps, to have been described separately. There is evidently a close resemblance between the calicles of all the Sandwich Island forms. This may be another instance of the similarity in surface characters of corals coming from the same waters, often noticed before in this Catalogue. However, as it is the growth-forms which mainly distinguish these Sandwich Islands *Porites*, Dana's *elongata*, with its long, tapering, moniliform stems, might well have been described separately.

82. **Porites Sandwich Islands (9)2.** (*P. Hawaiensis secunda.*)

[Sandwich Islands, coll. Wilkes Expedition, 1838–42; ?]

Syn. *Porites compressa* Dana, Zooph. (1848) p. 553, pl. liii. figs. 5, 5*a*, 8.
? *Porites compressa* Quelch, Chall. Rep. xvi. p. 180.

Description.—The corallum consists of erect sublamellate ridges fusing below almost into solid masses, but with their free-growing edges broken up into hatchet-shaped sections and lobes (lobed above or lobato-ramose). The lobes are compressed, from 12 to 16 mm. broad, sometimes much broader, 12 mm. high, and 7·5–10 mm. thick; not at all clavate. The living layer is 4 to 5 cm. deep.

The calicles are 1 mm. in diameter, neatly polygonal, quite shallow, plano-conical, about 0·25 mm. deep, and septa acute and very thin; corallum firm.

The clumps are 15 cm. and more across, and 10 cm. high.

From the figure of an enlarged calicle we gather (1) that the septa are also very irregularly united together: (2) that some six large interseptal loculi can be traced; (3) that there are granular pali at the meeting points of the septa; (4) an obscure central tubercle; and (5) that the flattened surface of the intervening wall has no specially noticeable feature, and is merely granular.

The shallow calicles, with their very thin irregularly fused septa with inconspicuous pali, suggest that this coral has a strong family likeness to other Hawaiian forms, viz. *P. Sandwich Islands 5, 6* and *7*. Unfortunately no specimens in the National Collection from the locality have anything approaching the growth-form described and figured.

Mr. Quelch proposed to identify the specimen called in this Catalogue *Porites Sandwich Islands 7* with Dana's type. While it is quite possible that the calicles were closely similar, it seems to me that, as we are compelled to adopt some method of grouping, however uncertain, we are in the case of these Sandwich Island *Porites* obliged to divide them according to growth-form. Without transition forms we cannot say that No. 7 (see Pl. XII. fig. 6) could also grow like No. 2. The three *Porites* which the British Museum possess from this locality all show very distinct growth-forms.

83. **Porites Sandwich Islands (9)3.** (*P. Hawaiensis tertia.*)

[Sandwich Islands, coll. Wilkes Expedition, 1838–42; ?]

Syn. *Porites lobata* Dana, Zooph. (1848) p. 562, pl. lv. figs. 1, 1*a*, *b*.

Description.—According to Dana's figure the corallum rises in smooth columns, fused together, and with the tops divided into rounded lobes. The living layer is at least 8 cm. deep, but in the text Dana says that it grows in deeply divided glomerate forms, not spheroidal, and sometimes rising into broad lamellar lobes or plates. The mass below often consists of broad, compressed, coalescing plates, 2·5 to 7·6 cm. thick.

The calicles are crowded, angular, "plano-conical," 1·5 mm. in diameter. The walls are very thin and somewhat ragged. The septa are very thin and acute, wavy, and with irregular edges, like those of the wall. They run in to join a small central columellar tangle. The pali are quite obscured.

This description is based upon Dana's figures and partly on his text. His description of the growth-form is not easily reconcilable with his figures. I have, therefore, followed the latter.

The thin-walled angular calicles, very uniformly distributed with obscured pali, are features which, coupled with the fact that the form comes from the Sandwich Islands, leads me to expect that the calicles were of the type of those in Nos. 5, 6, and 7, all of which, as we have seen, have a strong family likeness.

This form ought to be easily re-discovered. A somewhat similar form is described, but without figures, from Laysan, by Professor Studer (see Zool. Jahrb. xiv. (Syst.) (1901) p. 421).

84. Porites Sandwich Islands (9)4. (*P. Hawaiensis quarta.*)

[Sandwich Islands, coll. A. Garrett; ?]

Syn. *Synaræa irregularis* Verrill, Bull. Mus. Comp. Zool. i. (1864) p. 43.

Description.—The corallum "forms large irregular masses, consisting of numerous angular, uneven, and crowded branches, often nodose at the ends, and much coalesced, giving a rough eroded appearance to the mass."

The calicles are larger than in *P. Society Islands 3*, with "prominent, slender pali, columella rudimentary, often wanting. Surface covered with slender, prominent, often toothed granulations, which are rather loosely arranged. Colour, deep umber-brown."

Without any figure, it is difficult to make much of this description. The coral appears, from the shape of its branches, to have been a cœnenchymatous form, and if so, it is the only one, so far known, from the Sandwich Islands.

85. Porites Sandwich Islands (9)5. (*P. Hawaiensis quinta.*) (Pl. IX. fig. 8.)

[Honolulu (1–2 fathoms), coll. H.M.S. 'Challenger'; British Museum.]

Syn. *P. bulbosa* Quelch, Chall. Rep. xvi. (1886) p. 180, pl. xi. figs. 7, 7*a*.

Description.—The corallum forms clusters of short, thick stems, diverging fairly uniformly at angles of 45°; they are 4 to 5 cm. long, and 2 to 2·5 cm. thick; about half-way up they are regularly constricted. Above the constriction they swell prior to forking. The forking tips are often quite flat across the top. The flat top sinks in along a furrow preparatory to forking. The consecutive forkings are at short distances apart. The living layer is 6 to 7 cm. deep.

The calicles are 1·5 mm. in diameter, crowded, shallow, polygonal where sharply separated by thin walls, sub-circular where the walls are thicker. The former kind of wall, with sharp median ridges, occurs on the growing tops and on one side of stock, while on the other side they are thickened evenly and uniformly into a rather close granulated reticulum, often 0·5 mm. thick, and, to the naked eye, flat-topped, and making the calicles appear as sharp circular punctures in the surface. The septa are thin, tend to be lamellate, commence just below the aperture, and appear ragged and irregular, with a ring of septal granules, just detached from the wall in the thin-walled calicles. In the thick-walled calicles the septa are more regular, the septal granules are on the edges of the wall, and the septa themselves fuse in the four principal pairs. The pali are rod-like, but appear as small inconspicuous granules. The full formula can be usually seen, the lateral members of the ventral triplet being variable. A ragged columellar tubercle is usually present. The interseptal loculi are large and deep, but not sharply outlined, owing to the slight frosting of the sides of the septa. The calicles on the flat tops open in a spongy stroma, and are conspicuous from the large size of the columellar tangle, surrounded by rings of open interseptal loculi.

In sections of the stems the trabeculæ are well developed, but not crowded.

This coral is described by Mr. Quelch as being easily distinguished from the "*Porites mordax*" of Dana, from the same locality. The growth-form is different, and the living layer is much less extensive. But there is evidently a strong family likeness between all of these Sandwich Islands forms. The calicles of this type, at least where the walls are thin, are very like those of *Porites Sandwich Islands 6* and *7*, yet all differ in finer structural details. A strong family likeness between corals from the same locality has been frequently noticed in these Catalogues.

It is worth noting that while the calicles opening in the stroma on the tops of the stems are separated by thick reticular walls, those which are fully formed and ranged at the sides of the stem, have their walls thin and sharp; when these again thicken and become reticular, the reticulum is more rigid, and seems here and there to show slight traces of its formation out of an inner synapticular wall, although the reticulum in thickening stems would usually be due to the appearance of intervening tissue.*

This is one of the few Indo-Pacific *Porites* which show some approach to the characteristic method of branching seen in the West Indian forms.

a. Zool. Dept. 86. 12. 9. 312.
b (in spirit). Zool. Dept. 80. 11. 25. 217.

Mr. Quelch's figure of an enlarged calicle shows the fusion of the septa, but they are drawn as if fusing regularly into six pairs, whereas the fusing is that typical of *Porites*, as described in the Introduction, p. 13 (fig. 1, B).

Professor Studer mentions a stock, from Hawaii, 20 cm. broad and 12 cm. high, which he thinks to be of the same kind as this.

* See on this appearance of reticular walls in specimens of *Porites*, Introduction, p. 15.

86. **Porites Sandwich Islands (9)6.** (*P. Hawaiensis sexta.*) (Pl. IX. fig. 9; Pl. XII. fig. 5.)

[Honolulu, coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites lichen* Quelch (*non* Dana), Chall. Rep. xvi. (1886) p. 181.
non Porites lichen Bassett-Smith, Ann. & Mag. Nat. Hist. (6°) vi. (1890) p. 456. (See *P. China Sea.*)

Description.—The corallum is explanate and loosely encrusting. It attains at times a thickness of 1 cm. or more. The surface is crumpled into sharply raised, rounded or angular eminences as much as 1 cm. high. These are apparently due to the bendings, upheavals, and subsequent droopings of the growing and expanding edges. These latter are from 1·5 to 2 mm. thick. They are everywhere supported by epitheca.

The calicles are about 1 mm. in diameter, angular, deep, etc. The walls are usually very thin, but reticular in the angles (where shallow young buds appear), lattice-like, and with jagged edges. The septa are also thin and often lamellate, always with denticulate edges. They slope irregularly into the fossa, meeting when they reach the columellar tangle. The pali are formed by the jagged edges of the septa, and in the deeper calicles, in cases where the septa do not meet and fuse in pairs (cf. Introduction, p. 18), they are irregular and obscure; but in the shallower calicles the usual formula can be made out as eight small delicately frosted granules, straggling, and very extended. The fossa is deep, large, and open.

The columellar tangle is somewhat compact, with indistinct central tubercle, and surrounded by twelve large, open, rounded interseptal loculi, descending into the corallum. The skeletal elements are everywhere thin and delicate.

This is one of the 'Challenger' specimens from Honolulu, and was identified by Mr. Quelch with Dana's *Porites lichen*; but the mural network which characterised Dana's type is not especially striking here.

With this form Mr. Bassett-Smith provisionally identified one of his Tizard Bank specimens; but the much greater thickness of the skeletal elements, the larger size of the calicles, the longer, more slit-like interseptal loculi, and more open columella, are differences which require emphasising. See *P. China Sea 14.*

This specimen has a strong superficial family likeness to *P. Sandwich Islands 5* from the same locality; but the growth-forms are very different, while the fact that corals from the same regions tend to resemble one another has been already frequently noted.

a. Honolulu.	Zool. Dept. 86. 12. 9. 316.
b. 5 spirit fragments, 1 to 2 fathoms.	Zool. Dept. 91. 2. 24. 1.
c. 1 spirit specimen, 20 fathoms.	Zool. Dept. 80. 11. 25. 229.
d. Off Honolulu (spirit), 40 to 50 fathoms, obscured by the preserved polyps . .	Zool. Dept. 80. 11. 25. 215.

87. **Porites Sandwich Islands** (9)**7.** (*P. Hawaiensis septima*).
(Pl. X. fig. 1 ; Pl. XII. fig. 6.)

[Honolulu, coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites compressa* Quelch (*non* Dana) Chall. Rep. xvi. 1886, p. 180.

Description.—The corallum rises from an encrusting base into long, irregular ridges or crests, each 3 cm. high, and from 1 to 1·5 cm. thick, with smooth, flat, arched, or slightly over-hanging tops. The sides of the ridges are wavy. The ridges meet and fuse. The lower edges encrust the living layer, and are rarely free.

The calicles on the flat tops of the crests develop as shallow indentations in a delicate stroma of filamentous reticulum, with wide rounded meshes. The reticulum forms the walls which, except in the angles, are very thin; the septa are thin and lamellate, and soon join a central columella of open filamentous reticulum, similar to that of the walls. This columella reaches to the level of the wall. There are no traces of pali.

The ordinary lateral calicles are very angular, with conspicuous radial symmetry, about 1 mm. across, and are crowded and shallow. The walls are thin and sharp, and ragged rather than toothed. They rise slightly everywhere in continuous sharp edges above the level of the intra-calicular skeleton. In the angles they may thicken into small raised masses of reticulum in which young calicles may develop. The septa are of the same thickness as the walls, and show a strong tendency to be lamellate. Starting just below the edge of the wall, they rise a little, somewhat irregularly, to form a ring of septal granules, obscure in the young calicles, but pronounced in the adult, and giving them a ragged appearance. The septa meet and appear to fuse completely, but the triple fusion is not really completed—it is rather a fusion of the septa with the columellar tangle. Hence we have the complete palic formula, the pali being as inconspicuous as the septal granules, and mere ragged points on the edges of the septa. The columellar tangle forms a ring, and mostly develops a few cross strands from which a flattened columellar tubercle rises not quite to the level of the pali. The inter-septal loculi are open, but hardly conspicuous or sharply defined, owing to a frosting of the sides of the septa.

This coral was identified by Quelch with Dana's *Porites compressa*, but the whole method of growth in Dana's type was much more definite, and there is no evidence in the latter of an encrusting base, nor do the calicles appear to agree, judging from the indistinct drawing given in Dana's atlas.

I was at first inclined to think that the coral might be only a special growth of that last described from the same locality, but the walls in that coral are much higher and the septa more distinct, and appear to end freely round an open fossa. This is apparently another case of members of a genus from the same locality having a strong "family likeness."

The calicles, opening in the stroma on the top of the ridges here, have a less pronounced columellar tangle than have those opening on the flat tops of the stems in the *P. Sandwich Islands 5*.

a. Zool. Dept. 86. 12. 9. 311.

88. Porites Sandwich Islands (9)8. (*P. Hawaiensis octava.*) (Pl. X. fig. 2.)

[Honolulu, 1–2 fathoms, coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites tenuis* (*partim*) Quelch (*non* Verrill), Chall. Rep. xvi. (1886), p. 184.

Description.—The corallum closely encrusts stones with a layer about 5 mm. thick. Successive layers of the same thickness cover one another, and can be scaled off. Edges closely adherent.

The calicles are superficial, polygonal, and 1·5 mm. across if taken from median ridge to median ridge, but round and 1·25 mm. if the circumference of the interseptal loculi is the periphery of the calicle. The wall has a low frosted or finely toothed median ridge, and a flaky shelf on each side of it. Here and there the shelf is very porous, and the wall appears to be reticular. The rows of the pores are sometimes nearly regular enough to suggest the trimurate condition (see Introduction, p. 16). The septa are symmetrical, but slightly roughened, and septal granules appear at the edges of the flaky shelf. The interseptal loculi are conspicuous and open. The pali form a neat ring, and are frequently complete. The columellar tubercle is granular and smaller than the principal pali and slightly below their level. Itself seldom flattened, it may frequently be seen to rise from a directive lamella running across the whole calicle.

This coral from Honolulu is represented by a spirit specimen and a cleaned fragment which has been scaled off the living layer. The growth-form is peculiar, and deserves separate description. From the other Honolulan *Porites* it differs not only in method of growth, but in its calicle formation. There are no high membranous walls, and the pali are conspicuous. But on the other hand it may be noted that the thin skeletal elements, the open interseptal loculi, and their symmetrical septal formula, is common to all these Honolulan corals.

The absence of high walls in this specimen may be an adaptation to a detached life (cf. *P. Ceylon 9*). As the growth is all on one side, however, the stock, when collected, appears to have been stationary.

Mr. Quelch identified this form with *P. tenuis* Verrill. But *P. tenuis* was glomerate, whereas this, forming a rounded mass from encrusting a round stone, is really encrusting. The fact that layer covers layer with discontinuous growths separates this from true glomerate forms, in which the corallum thickens continuously. The rest of Dr. Verrill's description is so general that it might apply to almost any member of the genus.

a. In spirit (with a fragment freed from the soft parts in order to show the calicular skeleton). Zool. Dept. 91. 2. 20. 2.

89. **Porites Sandwich Islands** $_{(9)}$**9.** (*P. Hawaiensis nona.*)

[Hawaii and Molokai, coll. Dr. Schauinsland; Bern Museum.]

Syn. *Porites quelchii* Studer, Zool. Jahrb. xiv. (Syst.) (1901) p. 422, pl. xxxi. fig. 14.

Description.—The corallum is massive, with surface very uneven, closely covered with rounded or oval knobs and lobes, which combine to form larger ones. The lower edges, 3 mm. thick, are free and supported by epitheca, and several of them may be seen one over the other.

The calicles are variable in size, on the eminences large and hexagonal, 1·3–1·8 mm.; in the valleys, small and often squeezed out of shape. They are deep, from 1–1·3 mm.; the walls of varying thickness, from 0·5–1·0 mm., but tending to be thin and sharp. The septa project far into the fossa, and are nearly solid. They have two to three rough denticles along their edges, and echinulations on their sides which, deep down, form synapticulæ. The pali are irregular in number. The interseptal loculi are small, owing to the thickness of the skeletal elements, to the formation of synapticulæ and of the columellar tangle. In section the coral is very compact.

This description is taken from Professor Studer's text and collotype figure. The chief specimen was very heavy, about 15 cm. high and 14 cm. across. The whole growth-form is not given, but the surface is specialised more like that of *P. Ellice Islands 3* (Gardiner's "*purpurea*"), than like that of *P. New Hebrides 1* (Quelch's "*parvistellata*"), with which Professor Studer would compare it. The calicles of these different forms, however, have no resemblance whatever to one another. The description of the morphology of the calicle now given in the Introduction (pp. 13–21), makes it necessary to call attention to the three rough denticles or granules said to occur along the septal edges.

GULF OF CALIFORNIA AND BAY OF PANAMA.

90. **Porites Gulf of California** $_{(3)}$**1.** (*P. Californica prima.*)

[La Paz, Gulf of California (4–5 fathoms), coll. Capt. Pedersen; Yale College Museum.]

Syn. *Porites Californica* Verrill, Trans. Conn. Acad. i. part 2 (1867–71) p. 504.

Description.—The corallum is massive, encrusting, with surface rising into irregular lobes or branches. These are coarse, short, from 1·2–3·6 cm. in length, and 1·2–1·8 cm. thick, rounded at the top, often compressed or confluent into wide irregular lobes.

The calicles are rather large, 1 mm. in diameter, distinctly excavate, but not deep. The walls are very porous, and of moderate thickness. The septa are thin, sparingly spinosely granulated on the sides. Pali, five or six, small and prominent. The columella is rudimentary, spongy, often wanting.

This coral is picked up by divers near La Paz; and worn specimens are common on the beach. There is unfortunately no illustration with the description. The description, which is very good of the growth-form, is naturally insufficient with regard to the calicles. The stocks seem to be small, from 7·5–12·5 cm. high, and 15–20 cm. in diameter.

91. **Porites Gulf of California** $_{(3)}$**2.** (*P. Californica secunda.*)

[Near La Paz, coll. Capt. J. Pedersen; Yale College Museum.]

Syn. *Porites porosa* Verrill, Trans. Conn. Acad. i. part 2 (1867–71), p. 504.

Description.—The corallum is encrusting, with surface ridges with irregular lobes or branches, which are rounded at the top. Lobes or branches 1·2–2·5 cm. thick.

The calicles are small, 0·75–1·0 mm. in diameter, crowded, and shallow. The walls are thin, fragile, very porous, roughly spinulose, and lacerate. The septa are but little developed, thin and narrow, the edge roughly spinulose or lacerate, the sides with small spinule-like granulations. The five to seven pali are slender, prominent, roughly spinulose at top. The columella is small, porous, little developed, and often wanting.

The colour of the unbleached corallum is dark yellowish brown.

This *Porites* is said to differ from the one above by its "unusually porous texture, very thin walls and septa, and crowded cells or calicles."

92. **Porites Gulf of California** $_{(3)}$**3.** (*P. Californica tertia.*)

[La Paz, coll. Capt. J. Pedersen; Yale College Museum.]

Syn. *Porites nodulosa* Verrill, Trans. Conn. Acad. i. part 2 (1867–71), p. 505.

Description.—The corallum rises into small, crowded, frequently coalescing branches, rounded, not longer than 6–8 mm. These form together low, crowded clumps, 7·5–10 cm. in diameter, and 5 cm. high.

The calicles are moderately large, from 1–1·25 mm. in diameter, shallow, but clearly defined. The walls are thin, roughly lacerate, and porous; the septa roughly lacerate and spinulose, the sides covered with sharp rough granules; the pali five to six, short and stout, and roughly spinulose; columella little developed, spongy or trabecular.

This coral is said to be not uncommon on the beach, but mostly badly worn.

93. **Porites Bay of Panama (1)1.** (*P. Panamensis prima.*) (Pl. X. fig. 3.)

[Panama and Pearl Islands,* coll. F. H. Bradley; Yale College Museum and British Museum.]

Syn. *Porites Panamensis* Verrill, Proc. Boston Soc. Nat. Hist. x. (1866) p. 329.

Description.—The corallum is encrusting, thickening in the centre to a mound; stocks from 10 to 15 cm. across show a thickness of 1·2 to 3·6 cm. The surface is convex, irregular, and uneven.

The calicles are small, 0·75 mm., crowded, a little excavate, rather shallow but distinct; the walls rather thin, roughly granulous, porous, but firm.

The septa are well developed, narrowed and somewhat thickened outwardly, the sides very thickly covered with coarse, rough lacerate granules, the edges also rough and lacerate. Pali small and rather stout, roughly lacerately granulous. The columella is small, inconspicuous, and often wanting.

The colour of the unbleached corallum is dark ash brown.

This is Professor Verrill's description, to which is added the fact initialled by the collector (see Trans. Conn. Acad. i. part 2 (1867–71) p. 505) that the polyps when expanded "are exsert, with twelve equal, cylindrical, light-brown tentacles, not swollen at the tips, which are white."

There are fortunately two specimens in the British Museum also from Mr. Bradley's collection; they show the corallum closely adherent and without free edges. The irregularities of the surface are largely due to foreign organisms, e.g. Balanids, and the edges have very irregular outlines, putting out processes there, cut here into bays.

The calicles are irregular in size, and the walls very irregular in thickness. The details of wall formation are difficult to unravel owing to a woolliness of the surface. When they are thin there is a tendency to form a simple zigzag trabecular wall, from which the septa, thickened and roughened by fine spiky frosting, project into the calicles. Where they are thick they are raggedly reticular without trace of formal structure, but running out in all directions into thick frosted points. Near the aperture of the calicle the septa are short and free; the typical fusions can, however, be dimly made out deep down in the fossa, and five pali can be made out also spinously frosted. This frosting obscures the details of the intra-calicular skeleton, which, however, seen from above, is symmetrically radiate. The pali form a compact ring and are not conspicuous; they are more distinct, however, in the shallower calicles upon the thin expanding lobes of the edges.

There can be little doubt that these two specimens belong to the same form as that described by Dr. Verrill; the figure here given and these additional details were required to bring our knowledge of it up to date.

Both the specimens are greyish-brown, with whitish bloom over them, due to the hairy frosting, which is very remarkable.

a, b. Zool. Dept. 7. 8. 22. 18.

The other form from Pearl Islands described by Dr. Verrill as *Porites excavata* is a *Goniopora*.

* In rocky pools, and in patches just below low-water mark, the specimens may be sub-globular if they encrust small pebbles.

Group II.—AUSTRALIA.

GREAT BARRIER REEF.

I have experienced considerable difficulty in affixing the geographical title to many of the Australian specimens. The labels frequently record only "The Great Barrier Reef," without any exact locality.

The Great Barrier Reef as a district is clear enough, except at its northern extremity where it overlaps other districts, such as the "Torres Strait," "Gulf of Carpentaria," and "N.E. Australia." If only exact localities had been given, all the confusion would have been avoided. I have endeavoured to bring some uniformity by merging all forms labelled Torres Straits with those from the Great Barrier Reef. But those labelled N.E. Australia are in a separate group, except when their characters show them to belong to some known Torres Straits form, and then I have provisionally grouped them with that particular form.

94. **Porites Great Barrier Reef** (42)**1.** (*P. Queenslandiæ prima.*)
(Pl. XIV. fig. 1; Pl. XXI. fig. 1.)

[Capricorn Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum is explanate with smooth wavy surface, nearly 1 cm. thick where supported in the centre, but the edges, which project freely and horizontally, except that they show a tendency to bend up, have sharp edges (less than 1 mm.) and are supported by thick epitheca.

The calicles tend to be large (1·2 mm.) on the tops of the slight waves, round and shallow. The walls are mostly thick and round-topped, and composed of a very close, finely frosted reticulum; study shows traces of this reticulum being due to synapticular rings, but this is greatly obscured—it is chiefly seen in the fact that the septa can sometimes be traced through the wall, especially near the edges of the stock, where the septa all seem to be streaming outwards towards the margin. The septa, emerging from this reticulum and having their edges much broken up into granules, and their sides very frosted or rather echinulate, appear irregular, but they are in the typical formula, with here and there rings of small septal granules outside the pali, which are mostly in the complete formula (B, fig. 3). They form a ring conspicuous to the naked eye and surrounding a rather large fossa, with a small very inconspicuous central tubercle at a lower level than the pali.

In the section the trabeculæ are smooth and pronounced but far apart, separated by rows of nearly square holes, the horizontal elements being thin.

This *Porites* is quite different from all those yet described. It is especially interesting because it shows a tendency to produce the same kind of calicle as that which is typical of explanate Goniopores, a type which I believe comes nearest to that of the ancestral form (cf. Vol. IV. Introduction, p. 19, with Pl. XI. fig. 1).

a. Zool. Dept. 92. 12. 1. 269.

95. **Porites Great Barrier Reef** $_{(42)}$**2.** (*P. Queenslandiæ secunda.*)
(Pl. XIV. fig. 2; Pl. XXI. fig. 2.)

[Capricorn Islands, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into small, round, erect columns, close together, nearly smooth, and with rounded tops. The columns are from 4–5 cm. high and from 1–2 cm. thick. In large stocks they may all fuse together to form a stout, slightly expanding, fluted column, the top surface of which shows the several columns of which it is composed. The living layer extends 5–6 cm., the lower edge being hardly free, and with stout epitheca.

The calicles tend to be large, 1·5 mm., shallow, open, and rounded; on the top of the columns they open in a beautiful, delicate, almost filamentous stroma. The walls of the typical calicles on the sides are not thick, but tend to be reticular here and there, e.g. in the angles. They are otherwise thin irregular rows of loose, even ragged trabeculæ, sometimes thickened by the broad bases of the septa. The septa appear just below the edge as stout coarse granules, but they project very irregularly and at different depths below the wall; sometimes they run out, rod-like, to join the pali high up, at others only deep down in the fossa. Where he wall is thickened, traces of the inner synapticular ring are apparent. They fuse in the typical pairs. The pali are like tall bristles rising freely from the depths of the calicles, except where here and there one is attached as described to the wall by a septal rod. The ring of pali is large, loose, but conspicuous, nearly reaching to the height of the wall in the complete number (B, fig. 3), and all of nearly the same size. The fossa is deep, the columellar tangle not well seen from above as an open reticulum of few strands; the central tubercle is minute and below the level of the pali. The section shows the ragged trabeculæ very loosely arranged. The colour of the unbleached coral is dark sepia.

There are two specimens of this *Porites*. One consists only of three columns, the other is fused into a mass of five or six. The smaller one is from Capricorn Islands, the locality of the larger is given merely as "The Great Barrier Reef." In this latter the calicle skeleton is a little more frosted and thus less conspicuously open, the interseptal loculi being smaller. There can be very little doubt that these two corals are of the same kind, and in all probability both came from the Capricorn Islands.

On the larger specimen there is a young colony of *Alveopora* within its epithecal saucer, but greatly contorted by a calcareous alga.

a. Zool. Dept. 92. 12. 1. 350.
b (most probably also from Capricorn Islands). Zool. Dept. 92. 12. 1. 524.

96. **Porites Great Barrier Reef** $_{(42)}$**3.** (*P. Queenslandiæ tertia.*) (Pl. XIV. fig. 3; Pl. XIX. fig. 1.)

[Capricorn Islands, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises apparently as a small, rounded, but slightly compressed knob, about 1 cm. or more thick, which is followed by a second one on its summit. The shoulders of the lower one expand and form fresh knobs, so that tufts are formed of flattened flabellate stems, 4 cm. wide and 6 cm. high, with an irregular upper fringe of round knobs, and with the sides still showing the swellings of the knobs which have grown together. The living layer is from 4–5 cm. deep.

The calicles are very variable in size; the largest 1·5 mm. in diameter, the smallest being minute specks, mere shallow depressions. Rapid intra-calicular budding forms small wart-like prominences on the top of the knobs; these appear to be the beginnings of fresh knobs. The walls are very thin, ragged, or finely denticulate. On the tops of the knobs they are tall and fragile, but on the sides they are strengthened by a slight flaky shelf appearing just below their margins, and this becomes more and more pronounced, till on the sides of the flabellate stem the thin median ridge has disappeared, and the walls are flattened flakes. In the topmost calicles, the septa are thin, with very irregular edges, often rising at once to form a minute frosted septal granule, and further in, but rising from a deeper level, the pali. On the sides of the stock the septa become very irregular flattened flakes, the tips of which swell into knobs, some of which are septal granules, others, further in and from a deeper level, pali. The septal granules nowhere form a regular ring, but the five principal pali are very regular. The fossa is either open, circular and deep, or else filled with skeletal strands, from which a central tubercle arises, never quite so high as the pali.

The cross section shows the axial reticulum surrounded by very loose, irregularly nodulated trabeculæ, with distinct but not very thickened horizontal elements.

The colour of the unbleached coral is a greyish olive-green.

Other *Porites* with this peculiar moniliform growth are known (see Table III.). At first it seemed possible to unite this form with the next, but comparison of the descriptions will show how different they are.

a. Zool. Dept. 92. 12. 1. 306.

97. **Porites Great Barrier Reef** $_{(42)}$**4.** (*P. Queenslandiæ quarta.*) (Pl. XIV. fig. 4; Pl. XIX. fig. 2.)

[Capricorn Islands, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises from a small ridge-like base into a clump of irregular flabellate or roughly cockscomb-like processes—that is, they are this shape where they have

room to grow. Each process is apparently due to the fusion or forking of flattened, long oval knobs, which range from 1 to 1·8 cm. long and from 0·8 cm. to 1·5 cm. broad. Where there is little room, the knobs form small bunches with rounded or flattened stalks; the lower edge is closely adherent.

The calicles are irregular in size, inclined to be large, 1·25 mm., open, angular, not deep, with small groups of three and four surging up as the beginnings of knob formation. The walls tend to be rather tall, and then often membranous, with ragged edges showing traces of trabeculæ. The inside of the calicle is almost equally ragged; the septa come from the wall at different heights, being thick and sometimes flaky near the wall, with irregular development of septal granules. The pali form a large irregular ring of tall, bluntly tapering and roughened rods; the complete formula (eight) is common. A small tubercle rises in the centre. The calicles are conspicuous because the interseptal loculi and the fossa are open, and run freely into one another except where the septa are fused.

The section shows stout irregular trabeculæ, very loosely arranged, and far apart.

The colour of the unbleached coral is a light brown tinged with pink at the growing tips, and with olive-green near the base.

This coral clearly belongs to the series of forms with which we are now dealing and leads on to the next.

a. Zool. Dept. 92. 12. 1. 344.

98. Porites Great Barrier Reef $_{(42)}5$. (*P. Queenslandiæ quinta.*)

(Pl. XIV. fig. 5; Pl. XIX. fig. 3.)

[Capricorn Islands, coll. W. Saville-Kent; British Museum.]

Description.—The colony forms a small encrusting cap to the accumulations of previous growths, which progressively enlarge above the base. The edge is often free, and turned outwards for a few millimetres, and is then sharp (under 1 mm.) with prominent epitheca. The stock rises into a thick cluster of slightly compressed fusiform and angular lobes, swollen out above their bases, but pointed or crested at their tips.

The calicles are densely crowded, very deep, open, steeply funnel-shaped, angular, and irregular, being at all levels, one rising above the other. The largest are about 1 mm., and interspersed with young buds forming in the angles. The walls are uniform over the whole stock, and consist of simple rows of stout, long trabeculæ, making the edge a row of smooth, rounded granules; the steep sides are ribbed by the trabeculæ. The septa, and all the ordinary elements of the intra-calicular skeleton, are aborted or else quite obscured, deep down in the base of the calicle. Only the tall stout pali are visible some distance below the tops of the walls, and quite free from them. Usually only the four principal pali appear, but there are sometimes fewer. Here and there directives may be found, which may be either in contact with the wall, or with a

slight columellar tubercle, which is apparently at a lower level than the four principal pali; these latter are about the same thickness as the trabeculæ forming the wall.

The section shows a loose trabecular structure with an absence of horizontal elements unparalleled in the genus.

The colour of the unbleached coral is a dark tone of sepia.

This coral was for long very difficult to classify: the discovery of the typical palic formula of *Porites* sets the matter at rest. For not only are the four principal pali recognisable as such by their positions, but diligent search showed traces of other parts of the formula, viz. the two directives and the columellar tubercle.

As can be seen from the description and the figures, this is quite an extreme form of *Porites*. It, however, links on with the forms Nos. 2, 3 and 4, which are also from the Capricorn Islands, for they all show the tendency to extreme looseness of the trabeculæ in the vertical section.

a. Zool. Dept. 92. 12. 1. 276.

GREAT BARRIER REEF—PALM ISLAND.

99. **Porites Great Barrier Reef** $_{(42)}$**6.** (*P. Queenslandiæ sexta.*) (Pl. XIV. fig. 6; Pl. XIX. fig. 4; Pl. XXI. fig. 8.)

[Palm Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum is explanate, attached by the centre or side, and with edges expanding freely on a wrinkled epitheca, usually drooping, and sometimes curled up. From the otherwise smooth surface arise mammillate processes about 1 cm. thick and from 1–2 cm. high, usually swollen, or even forking at the tips.

The calicles average 1 mm. in diameter, but vary according to position. The walls on the level portions are either thin and raggedly trabecular as rows of separate frosted points, or else rather wide, with an irregular fine branching arrangement of trabeculæ, hardly forming a reticulum, the granules being finely echinulate; these give the surface a woolly appearance, but here and there the walls actually become irregularly reticular, and small groups of calicles with such walls tend to rise to form the mammillæ. The septa are straggling bent processes, about as thick as the wall trabeculæ, very irregular, and sometimes, especially near the edges, projecting from the walls as flakes. They are of very irregular lengths, and appear at different heights on the wall, the radial symmetry being much obscured. The pali are tall, thin rods, conspicuous to the naked eye as a ring. The ordinary formulæ (C or F, fig. 3) are most common, but several others appear. An inconspicuous columellar tubercle appears, often flattened in the directive plane. To the naked eye the calicles show the ring of pali with a minute central pinhole fossa inside, and a distinct furrow outside between the ring and the wall.

The section shows an interesting outward streaming near the epitheca, and from this the trabeculæ bend upwards. The latter are very loosely arranged, being far apart and rather wavy than nodulated, joined by thin, straggling cross-pieces.

The colour is a rich light brown, with the tips of the mammillate processes suffused with a rose pink.

This growth-form, consisting of clusters of mammillæ rising from an explanate corallum, has already been described (see *P. Fiji Islands 24*), and it is interesting to note the somewhat similar woolly appearance and looseness of the trabeculæ in the two cases. But their calicles appear very different.

There are two specimens—*a* shows a cluster of two stocks with drooping edges. This is from Palm Island.

a. Zool. Dept. 92. 12. 1. 363.

Specimen *b* has the edges curled up and crumpled, as if the stock had not had room enough to expand. This has forced it to be saucer-shaped, a difference in shape which will more than account for any differences in the characters of the calicles. It is of a richer brown colour, and is labelled only "Great Barrier Reef," but it was most probably also from Palm Island.

b. Zool. Dept. 92. 12. 1. 538.

100. **Porites Great Barrier Reef (42)7.** (*P. Queenslandiæ septima.*) (Pl. XIV. fig. 7; Pl. XXI. fig. 3.)

[Palm Island, coll. W. Saville-Kent; British Museum.]

Description.—The exact growth-form of this coral is difficult to understand, because there is no means of deciding for certain as to what was its natural position in life.

It is massive, and its wavy but otherwise smooth surface seems as if it might have been swept over to one side by a current so as to form great smooth rounded lobes, the most advanced of which project freely in a horizontal position. The edges are thick, but hardly project. The inner parts of the stock are honeycombed by a boring sponge.

The calicles are shallow, but conspicuous, 1–1·25 mm., with many minute young in the interstices. The walls, composed of large, coarse, shapeless granules, run as stout ridges like a network over the corallum, and are in one or more rows. These are the tops of thick trabeculæ, and, on a slanting view of the surface, stand up freely without any superficial concentric elements joining them. The septa are deep down as thick bars, or triangular plates, joining the wall trabeculæ to the pali. These latter form a neat conspicuous ring of five knobs; the fossa is either filled with skeletal matter, or is deep and open like a puncture. Between the septa the interseptal loculi show as an irregular ring of dark slits, narrow or triangular, with their mural ends sharply pointed.

The colour of the unbleached stock is very dark sepia. The section is built up of thick trabeculæ.

This coral stands alone in the character of its surface, being composed entirely of the tips of stout trabeculæ. The septa, the deep fossa, and the interseptal loculi can only be seen by bleaching. For another instance of remarkable trabecular development, see *P. Great Barrier Reef 5*, but the trabeculæ in that form rise as tall rods above the surface.

a. Zool. Dept. 92. 12. 1. 310.

101. **Porites Great Barrier Reef** $_{(42)}$**8.** (*P. Queenslandiæ octava.*) (Pl. XIV. fig. 8; Pl. XXI. fig. 4.)

[Palm Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum forms a swollen, flat-topped knob, narrowing towards the base and attached by a thick stalk. The top surface is covered with narrow, wave-like ridges running out towards the edge which projects furthest from the stalk. The living layer is some 3–4 cm. deep: the edge is bent under round the stalk, and is closely adherent.

The calicles are slight, very ill-defined depressions in a rough surface, from 1–1·25 mm. in diameter. The walls are not very thick, and consist of an irregular mass of large frosted granules. They are too irregular to form any sort of median ridge (except here and there in valleys or depressions). The septal edges are more regular and wedge-shaped, as rows of similar granules which tend to be square, or oblong transversely to the septum. Between these rows very narrow interseptal loculi, straggling and of uneven widths, run high up, and even, at times, between the granules, over the walls, while there is always a marked tendency for fine concentric furrows to appear between the wall and the septal granules, and again between the septal granules and the pali. These sharp, concentric furrows only become pronounced in the shallow calicles on the under surfaces. The four principal pali are large and conspicuous, and are easily rubbed off the dried corallum. The remaining pali are not always easy to distinguish from the septal granules, for none of them rise much higher. Compare the formula, Diagram E, fig. 3 (p. 19). The columellar tangle is dense, granular, and circumscribed, and an obscure central tubercle can be seen.

The only specimen of this coral is 6 by 7 cm. across the flattened top. The whole stands 6 cm. high, 2–3 cm. of which is the dead base, thickly coated with calcareous algæ. Upon this latter dead portion a very young colony apparently of the same coral can be seen as a small, nearly symmetrically hemispherical knob. It consists of five calicles, but unfortunately, like the adult colony, it has suffered by the rubbing off of the large frosted granules from the upper edges of the walls, which, therefore, look somewhat smooth and dense.

The peculiarity of the coral is that it appears as if it were entirely built up by an aggregation of frosted crystalline granules, and this appears even in the section across the base—which is the only section available for examination.

a. With a very young colony attached to its base. Zool. Dept. 92. 12. 1. 351.

102. **Porites Great Barrier Reef (42)9.** (*P. Queenslandiæ nona.*)
(Pl. XIV. fig. 9; Pl. XIX. fig. 5.)

[Palm Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into erect but very irregular columns or crests, the top forming level ridges, and the sides descending steeply down, either vertically or even overhanging. The living layer streams down 8–9 cm., with edges usually closely adherent.

The calicles are conspicuous, 1 mm. in diameter, mostly sunk singly or in rows, and down the sides in groups between smooth, rounded, cœnenchymatous ridges. On the tops, where the ridges are a fine delicate woolly reticulum, the calicle skeleton can be seen to be an arrangement of its threads, which run down and form the septal edges. On the sides where the ridges are coarser and granular, the septa are far thicker, as broad, coarse, frosted flakes projecting far into the calicle, and carrying at their tips a conspicuous ring of large, frosted pali, which are very variable, and show all the ordinary formulæ. The interseptal loculi are long, very irregular slits which are gashed far back into the cœnenchymatous ridges. The fossa is deep, and a minute tubercle can often be seen far down.

There are three of these cœnenchymatous corals, all from Palm Island, and all with substantially the same type of calicles, and yet no two of them are alike in the character of the ridge formation. In *a* the swellings are large, rounded, and run right down the sides, raising the whole surface into small subsidiary excrescences. This is the largest and most vigorous growth, the top being broken up into angular, flat-topped columns.

a. Zool. Dept. 92. 12. 1. 278.

Specimen *b* has much smaller and less vigorous ridge-formation, and the sides rise up more smoothly. The tops of the ridges are a brilliant lake colour.

b. Zool. Dept. 92. 12. 1. 5.

Specimen *c* has quite a different aspect from either *a* or *b*, and but for the similarity in the types of the calicles, it would have been described separately. It is a single flattened ridge-like stock, with its lower edges free and turning outwards. The cœnenchymatous ridges are very pronounced, but not as rounded, woolly knobs, for they run together and gyrate over the surface. The chief difference is seen in the texture, the elements of the swellings being far coarser than in *a* or *b*. Those of *b* are the finest and most delicate.

c. Zool. Dept. 92. 12. 1. 282.

103. **Porites Great Barrier Reef (42)10.** (*P. Queenslandiæ decima.*)
(Pl. XV. fig. 1; Pl. XIX. fig. 7.)

[Palm Island, coll. W. Saville-Kent: British Museum.]

Description.—The corallum rises into flat-topped flame-like columns, with sharp irregular ridges running up the sides and standing up as blunt points on the tops of the columns.

Between the ridges and points the surface is quite smooth. The living layer is 5·5 cm. deep, and the edges show only a slight tendency to bend outwards.

The calicles are seen scattered about, sometimes crowded, sometimes distant, as minute reddish or orange-coloured* specks, slightly raised above the smooth pale-pink surface, their outlines not easily defined. They are not confined to the valleys, but occur over the whole surface, even on the ridges. The septa are small, flat, triangular flakes or thick threads, which slope gradually upwards, forming a rampart round the minute pin-hole fossa. The tips of these septa are frosted and irregular, but they can be seen to fuse in pairs, and V-shaped pali are produced. Rings of these pali form neat round bosses, rising above the surface. The interseptal loculi run freely into the gyrating fissures of the smooth cœnenchyma, which, under the lens, is seen to consist either of flakes, with finely frosted edges, or of frosted threads.

This form is entirely different from the three specimens just described. Not only are the calicles dissimilar, but their cœnenchymatous specialisations are also quite different.

a. Zool. Dept. 92. 12. 1. 279.

104. **Porites Great Barrier Reef** $_{(42)}$**11.** (*P. Queenslandiæ undecima.*)
(Pl. XV. fig. 2; Pl. XIX. fig. 8.)

[Palm Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises in thin, flattened, slightly bent stems, which are greatly flattened, and fuse into leaves. The stems fork irregularly. The upper edges of the leaves are only slightly notched. The stems and leaves are about 6–8 cm. thick, from 1–4·5 cm. broad, and about 4 cm. free above the common basal stem. The depth of the living layer is unknown, at least 6 cm.†

The calicles are large, 1·5 mm., shallow but conspicuous, on account of the ring furrow separating the walls from the pali, which themselves surround a fossa visible to the naked eye. The walls consist of a single (sometimes double) rather irregular row of separated glassy, knobbed or frosted granules, which rise above solid-looking flakes. The septa project as broad, irregular flakes, which meet and fuse in the typical way. Large septal granules may rise near the wall. The pali form a conspicuous ring of frosted knobs, showing both formulæ (B and C, fig. 3). They rise as high as the wall. The fossa is conspicuous from its size; there is generally a central tubercle. The interseptal loculi are narrow, but often run right up to and in between the wall granules into the next calicle. The texture of the coral is

* Which show black on the photograph, Pl. XIX. fig. 7.

† Mr. Pace informs me that a *Porites* something like this forms great staghorn-shaped masses, 4–5 ft. high, where the reefs dip down steeply. Palm Island is far from the Torres Strait, where Mr. Pace collected, and it is doubtful whether the two corals are of the same kind.

thin and loose; in section, the trabeculæ are seen to be short but far apart, with a great development of the horizontal elements. The colour of the unbleached coral is a sepia, with a greyish bloom caused by the glassy granules.

This *Porites* is one more of those with the horizontal skeletal elements specially developed. Its growth-form is different from that of any other *Porites* yet known.

a. Zool. Dept. 92. 12. 1. 348.

105. **Porites Great Barrier Reef** (42)**12.** (*P. Queenslandiæ duodecima.*) (Pl. XIX. fig. 6.)

(Palm Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into thick, smooth, flattened, wavy or curving stems, which seem to fork dichotomously at about every 2 cm. of their length. The tips of the branchlets flatten greatly, and expand prior to forking. The stem may be 2·5 by 1·8 cm. in long and short diameters. The branchlets, which are nearly cylindrical, except at their tips, are 2 cm. long and 0·5 cm. thick.

The calicles are very obscure in the smooth, finely granular, almost velvety surface. They appear only as dark stains, about 0·75 mm. in diameter, and quite flush with the surface. The walls are broad, of irregular thickness, 0·5 mm. or more, flat, apparently nearly solid, and smooth. Their tops are covered by numbers of flattened granules, without any recognisable order, except that some are the wall granules at the roots of the septa, and from these others may run in straggling lines across the wall. Within the calicle, as is usual in these branching trabecular *Porites*, only large, rather closely packed, granules can be seen. The outer ring of septal granules is almost in contact with the walls. The pali are large and very close to one another and to the septal granules. The formula is rare and seems mostly to be like H, fig. 3 (p. 19). A central tubercle rises in the fossa as high as the pali.

The cross section shows a very close cross network consisting of stout radial trabeculæ, not very crowded, joined by concentric rings, also stout, and close together, but perhaps not quite so developed as the trabeculæ.

Both in growth-form and size of calicle, so far as known, this branching form of *Porites* is unique.

a. Zool. Dept. 92. 12. 1. 309.

GREAT BARRIER REEF—GREEN ISLAND.

106. **Porites Great Barrier Reef (42)13.** (*P. Queenslandiæ tertiadecima.*)
(Pl. XV. fig. 3; Pl. XXI. fig. 5.)

[Green Island,* coll. W. Saville-Kent; British Museum.]

Description.—The corallum is massive (?globular). [There is only a small sector with smooth triangular surfaces split along the trabeculæ, showing that the coral must have been thick.] The surface was smooth, but slightly wavy.

The calicles are small, under 1 mm., crowded and angular. The walls are simple, straight, sometimes incomplete; they are jagged and irregularly granular, rather than zigzag. The septa start just below the edge of the walls, which thus appear slightly raised; they are very rough, like the walls; they are thickened by synapticulæ round the periphery, sometimes making an inner wall ring. In the more regular calicles the pali form a complete ring of small roughened granules, rather deep down and inconspicuous. They rise from a skeletal ring, and are joined symmetrically with a small central tubercle still deeper down, so that one bar of the regular columellar tangle runs in the directive plane, and may result in the trident formation shown in Diagram G, fig. 3. Groups of calicles occur in which these regular features are quite lost.

In the vertical section the light brown colouring matter of the living colony extends 4–5 mm. deep. The trabeculæ are stout, almost ribbon-like, and separated by narrow rows of pores.

I have so far found no *Porites* which compares well with this.

a. Zool. Dept. 92. 12. 1. 343.

GREAT BARRIER REEF—ROCKY ISLAND.

107. **Porites Great Barrier Reef (42)14.** (*P. Queenslandiæ quartadecima.*)
(Pl. XV. fig. 4; Pl. XXI. figs. 6, 7.)

[Rocky Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum is massive, with smooth rounded surface, and living layer closely adherent at the edges, which bend under. [The specimen is a small, long oval ridge,

* This island is ten to twelve miles east of Cairns. See 'The Great Barrier Reef,' p. 112.

growing upon a somewhat similar oval ridge which had been overturned; the otherwise smooth surface shows traces of cross furrows.]

The calicles are small, under 1 mm., crowded, shallow, but distinctly depressed. The walls are variable and difficult to unravel, but show a thin, and inconspicuous, because often incomplete, zigzag line. From this the jagged and bent septa branch outwards to various distances, and slope downwards into the calicle. These septa may sometimes form an inner synapticular ring when wall and septa thicken; the fact that this inner ring is often complete makes it appear as if the wall were nearly solid and irregularly striated by very jagged or granulated septa. The thin-walled calicles occur on the top, where growth is most rapid; those with thick walls, on the lower surfaces and especially at the sides. The sloping septa are irregular rows of coarse granules, so that the intra-calicular skeleton appears confused and broken up. The pali show large coarsely granular principals, but the ventral triplet has no fixed order, the three minute granules being variously arranged. The central tubercle is minute and deep down, the columellar tangle being quite obscure.

In addition to the small specimen here described, there is what appears to be a second specimen of the same coral. The analysis of the calicles shows a similar structure, the differences being attributable to superficial variations of surface texture. Whereas in specimen *a* the skeleton is rather indefinitely coarsely granular, in *b* the skeleton is smoother but with sharp echinulations, and the granules are neatly star-like.

Specimen *b* (Pl. XV. fig. 4) seems also to have started as a long oval ridge, which gave rise to others variously attached. Indeed, upon the dead part of the specimen when collected, the living layer formed a nearly spherical knob, 4 cm. in diameter, upon an irregularly prolonged end of a former ridge (Pl. XXI. fig. 6). The calicles which are growing fastest at the top of the knob have smoother and very incomplete skeletal elements, but elsewhere the calicles differ from those of specimen *a* almost entirely in the fact that the skeletal elements are neatly echinulate instead of being indefinitely granular.

There is a young encrusting colony about 1·5 cm. long by about 1 cm. across, which is apparently a new growth of the same coral.

a. A small ridge growing upon a previous ridge which had been overturned . .	Zool. Dept. 92. 12. 1. 323.
b. A globular knob, growing from an irregularly prolonged end of a ridge, upon which is a very young encrusting colony showing the beginning of the ridge formation. .	Zool. Dept. 92. 12. 1. 342.

108. **Porites Great Barrier Reef** $_{(42)}$**15.** (*P. Queenslandiæ quintadecima.*)
(Pl. XV. fig. 5; Pl. XXI. fig. 12.)

[Rocky Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises as a thick ridge, the top of which swells into an irregular clump of nodules, too short to be called branching. The living layer is 4 cm. deep, and

appears to be creeping over and closely encrusting the surface of some of the topmost nodules of an earlier growth. The whole stock is very dense and stony.

The calicles appear as ill-defined but conspicuous indentations, irregular in size and distribution, shallow, sub-circular, but star-like when seen from above, about 1 mm. or more in diameter. The walls are thick, swollen, and round-topped, with a distinct tendency, which is pronounced in sheltered spots, to form a blunt median ridge, so as to make the calicular depressions funnel-shaped. They are built up of a confused and close tangle of flaky reticulum, and hence are without true granules, and appear smooth and solid. The septa are ragged and wavy, sometimes as flakes with echinulate or frosted edges. They usually meet in the typical manner. The fusion into four pairs is constant, and from the tips of the points of fusion knobs or swellings represent the principal pali, but they are often quite obscure. The triplet is less often seen. The six interseptal loculi, as irregular wavy slits, open into the central fossa, and descend deep and conspicuous round the confused columellar tangle, which slowly fills up the fossa. From it usually rises a small columellar tubercle.

The section of the stock, which is heavy and tough, shows that the elements are very stout, with large pores between. There are great numbers of delicate tabulæ from 0·25 mm. to 0·3 mm. apart.

The single specimen of this coral presents many variations of calicle structure: in the valleys and protected parts the calicles are visibly star-shaped owing to the depth and symmetry of those interseptal loculi which open into the fossa. On the tops and outer faces of the nodules, i. e. in the most exposed places, the reticular walls are so thick and dense, and the intra-calicular skeleton so irregular, that the calicles are only seen as slight depressions in a solid stony surface, and with very obscured radial symmetry. Elsewhere the calicle skeleton is very pronounced, but is remarkable in the feeble development of the pali.

a. Zool. Dept. 92. 12. 1. 352.

109. Porites Great Barrier Reef (42)**16.** (*P. Queenslandiæ sextadecima.*) (Pl. XV. fig. 6; Pl. XXI. fig. 9.)

[Rocky Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into a clump of nodules. The clump is about as broad as high, the nodules being small, rounded, compressed, and at the top of the stock rather flat-topped. On their surfaces, groups of calicles can be seen surging up to form fresh knobs. The living layer descends 4 cm., and the creeping edge, which is rather thick, is closely adherent.

The calicles are small, shallow, but distinctly depressed, very irregular in size; the larger about 1 mm. in diameter, and sub-circular. The walls vary greatly in thickness, and they appear to consist of an open ragged mass of thin, angularly-bent threads. In thick walls these are arranged as a reticulum, but in thin walls only a few scattered threads appear. In all cases this top wall-structure, reticular or not, seems to rise from flakes obscured in the

upper, but coming more to the surface in the lateral calicles round the base. The septa are irregular and obscure; they appear round the inner margin as loose threads of the wall reticulum. The radial symmetry, usually obscure, is not seen in the lateral calicles round the base. In these the septa are short, and the palic ring large. In less symmetrical calicles the palic ring may be much smaller, and the septa longer. In the small rings the number of pali may be four or five; in the larger seven or eight. The exact formula in the latter case is, however, obscure. There is a central tubercle and an obscure columellar tangle.

The section of an edge shows a kind of wavy streaming of flattened trabeculæ joined together by cross-pieces, leaving oval pores. The tops of the knobs show traces of a deep rose-pink, while the valleys between the knobs are a greyish green.

This coral should be compared with the next. It is like it in general structural features, and yet very unlike. There is, however, no such evidence as there was in the cases of specimens *a* and *b* of *P. Great Barrier Reef 14*, to lead us to suppose that the differences are due solely to subtile differences in the texture of the skeleton. When this can be shown, we have nothing to do but to unite the specimens under one heading, for such fine differences of texture are almost certainly mere local variations.

a. Zool. Dept. 92. 12. 1. 325*a*.

110. **Porites Great Barrier Reef** (42)**17.** (*P. Queenslandiæ septimadecima.*) (Pl. XV. fig. 7.)

[Rocky Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises from an expanding or pendent creeping base into a cluster of short, bent processes of quite irregular size and shape, knobbed, pointed, forking, or without any definable form. The basal edge adheres to the substratum, and is about 2 mm. thick.

The calicles are slightly over 1 mm., shallow, not closely crowded, sub-circular. The walls appear open and incomplete, as a delicate irregular system of branching granules, which, just below the surface, unite to form a reticulum, in which no clear traces of radial and concentric symmetry can be seen. Down the sides and round the bases these surface granules enlarge into flattened flakes with frosted edges. Beneath these, a lower flaky layer can be seen, which again is most pronounced on the sides and base. In the growing tips the calicles are opening in a streaming reticulum, with all their skeletal elements looking like very thin smooth, vertical laminæ, and their walls as a fine open filamentous network, contrasting strongly with the large horizontal flakes with coarse surface granules on the sides and round the base. The septa, except quite at the tips, are thick, with very irregular sides; they gradually become broad triangular flakes. The septal granules are usually merged in the wall reticulum. The pali are not conspicuously distinguishable from the other granules of wall or septa, except by their forming a ring, usually of five. There is a columellar tubercle, also distinguishable chiefly by its position.

In a section of a branching process the axial reticulum is seen to consist of stout threads with large open pores. The radial (trabecular) elements show no pronounced development over that of the concentric (horizontal).

The unbleached coral is a faint grey-green, with traces of rose-pink at the tips of the processes.

It will be seen from the description how many points this coral has in common with that last described, but the differences between them are so great that until we know more about their affinities from observation on the reef, we must describe them separately. The calicles show no resemblance whatever, and the growth-forms, though fundamentally the same, show very striking differences in detail.

Branching forms with a flaky skeleton have already been described (see below, Table III., for a list of forms showing the same remarkable character).

a. Zool. Dept. 92. 12. 1. 156.

111. **Porites Great Barrier Reef (42)18.** (*P. Queenslandiæ octavadecima.*) (Pl. XV. fig. 8.)

[Rocky Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum forms clusters of thick, short, rather stiff, erect stems, the blunt tops of which divide up irregularly into new clusters. The thickness of the basal stem is about 2 cm.; of the branchlets, from 1–1·5 cm.; and the length of the latter, about 3 cm. The living layer is about 6 cm. deep. [As the layer extends much further down one side than it does on the other, it is probable that this specimen was one of the outermost fragments of a much larger stock. In large clusters the colony usually extends very much lower round the periphery than it does down any of the central branches.]

The calicles are superficial, about 1 mm. in diameter, and as mere marks in the smooth, velvety surface. The walls are broad, flat and granular, the granules being small, echinulate, and apparently rising from a solid layer. In bleached portions the flat, solid layer is seen, in parts where the granules are few and scattered, to have very fine pores in it. The septa are thick and symmetrical, running straight out from the edge of the solid wall. They swell at once into a ring of septal granules, and again into pali. The whole formula (eight) is present, but only the four principals are conspicuous; the rest are short. There is a columellar tangle, the central tubercle appearing only deep down.

In transverse section the radial trabecular elements are more conspicuous than the concentric, which are, however, stout. They are very compactly arranged, the pores being small and the coral consequently very dense.

This, it will be noted, has the usual aspect and structure of so many branching *Porites*—the surface velvety and granular, and the calicles superficial. The rich brown colour of the dried specimen is also to be noted as that common to the majority of such forms. In this case the granules are very fine, and the shape of the branches is peculiar.

a. Zool. Dept. 92. 12. 1. 3.

GREAT BARRIER REEF—TORRES STRAIT.

112. Porites Great Barrier Reef (42)19. (*P. Queenslandiæ nonadecima.*)

(Pl. XV. fig. 9; Pl. XX. fig. 2.)

[Warrior Island, Kelly's Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises from an encrusting, laterally expanding base, into a loose irregular mound-like cluster of knobs, blunt points, ridges, and bent, rounded and flattened processes varying in size, thickness and height. The explanate base may run out into drooping tongues, but never projects far from the basal support; its edge may be 1·5 to 2 mm. thick.

The calicles are conspicuous, shallow, almost superficial on the basal surfaces, very variable in size, from 1·5 mm., and well spaced on swollen convex surfaces, very minute, but still not very crowded in the valleys and depressions. The walls on the tops of the processes are slightly raised as a rather thick flaky reticulum with a sharp median edge. Down their sides the flakiness gradually increases, the raised median portion becomes a row of frosted crystalline granules, which almost disappear, until the top of the flat wall consists of long, crisp flakes, with rounded tongues and points frosted at their edges and tips. The septa, except at the growing tips of the stock, which consist of a delicate flaky reticulum, very soon greatly thicken. They are short, and set with broad bases (? the homologues of the septal granules) on the wall. The ring of pali, which are usually complete (cf. formula B, fig. 3, p. 19), is large, and rises to the level of the wall, but owing to the raggedness of the wall flakes there is no clear ring furrow running between it and the wall. There is a central tubercle rising from a fairly symmetrical columellar tangle; skeletal bars seem to radiate from the tubercle to the pali, but rather deep down.

The section of a process shows a very loose porous texture; the trabeculæ, though more conspicuously symmetrical, are not better developed than the horizontal elements which form the flakes.

The colour of the unbleached coral is a stony grey-brown.

The coral seems to be very nearly related to that described below as *Great Barrier Reef 24*, from Thursday Island; the growth-form is so like that I am inclined to believe there may be some mistake in the labels, and that they came from the same place (see further remarks on p. 128).

There are two specimens, one (*a*) a large, nearly complete cluster from "Kelly's reef," and a fragment (*b*) which fits on to a fracture of *a*; this latter is labelled "Warrior Island." Mr. Pace informs me that in both Warrior Island and Thursday Island many spots are called after a celebrated diver of the name of Kelly.

Here again we have the horizontal elements of the reticular skeleton developed as flakes.

a. A nearly complete stock. Zool. Dept. 92. 12. 1. 143.
b. A fragment of *a*. Zool. Dept. 92. 12. 1. 276.

113. **Porites Great Barrier Reef (42)20.** (*P. Queenslandiæ vicesima.*) (Pl. XVI. fig. 1; Pl. XXI. fig. 10.)

[Friday Island Passage, coll. S. Pace; British Museum.]

Description.—The corallum forms a roughly oval mass, with wavy surface. It is 7 cm. long by 4·3 cm. in thickest diameter; the edges are inclined to be closely adherent, except when they cover over foreign bodies. [Mr. Pace informs me that it was attached by its lower end to the flexible stalk of a *Zostra*.]

The calicles are small, 1 mm., inclined to be deep at the upper end of the stock, crowded and angular. The walls are everywhere simple, very thin, and with a tendency to be zigzag, only the trabeculæ are very incompletely joined together, so that the edge of the wall seen from above is frequently a row of frosted points variously joined by thin skeletal bars. Seen laterally, the walls are palisades of tapering bars very incompletely united. The septa are very thin, slightly granulated, and, seen from above, quite straight and symmetrical; they project, however, at very different heights from the wall, a few from the extreme edge and the rest lower down. There are traces of rings of wall granules and septal granules, the upper edges of the septa being much interrupted. The pali themselves are not conspicuous, nor (owing to the porosities of the septa) very regular, for the granules at the points of fusion of the latter are frequently incomplete; the formula consequently varies. The ring itself is small, and the central fossa deep, with a large tubercle deep down in its base.

The colour of the unbleached stock is a bright red-brown.

There is only one specimen, which Mr. Pace told me rocked about freely, being attached to the flexible stalk of an alga. In Vol. IV., cases of *Goniopora* were described, especially some in the Paris Basin, in which it was fairly clear that they had been attached to algæ. This is the only case I have come across of a *Porites* attached to a weed. Ortmann described representatives of the genus from Dar-es-Salaam growing among weed, and apparently without any attachment. The phenomenon might be expected where the bottom consists of sand and weeds.

In shape, colour and general character, the coral is not unlike *P. New Hebrides 1* (= *P. parvistellata* of Quelch).

a. Zool. Dept. 1904. 10. 17. 39.

114. **Porites Great Barrier Reef (42)21.** (*P. Queenslandiæ prima et vicesima.*) (Pl. XVI. fig. 2.)

[Thursday Island, coll. S. Pace; British Museum.]

Description.—The corallum is explanate, thin, encrusting, with surface mostly smooth or slightly wavy. The edges are adherent and 0·5 mm. thick. The stock thickens to 5 mm. in a specimen nearly 4 cm. across.

The calicles are very slightly depressed, almost superficial, small, about 1 mm., sub-circular.

The walls are broad, and flat-topped round the edges and on the higher parts of the surface. They consist of a very delicate and elegant filamentous reticulum, beset with small blunt points like a filigree; into this the interseptal loculi are gashed back, so that their shapes are almost petaloid; threads of the filigree may sometimes form a zigzag border. In the depressions the calicles are minute, and the walls reduced to single zigzag lines, often incomplete.

The septa show the same blunt points on their sides and edges, making them look crisp and irregular. They are often incomplete, the ventral triplet being then reduced to a single directive. Those which are developed are long, with septal granules like portions of the wall, and pali like small inconspicuous stars with blunt rays. The ring of pali is small, and their number varies from four to six, according as the directives carry pali or not. The columellar tubercle and tangle are deep down and obscured.

The vertical section is delicately and elegantly trabecular. The colour of the unbleached stock is light yellowish brown.

This elegant little form is unlike any other known explanate *Porites*.

a. An unbleached stock, nearly complete. With this are *b*, a bleached fragment of the same, broken from the edge, and *c*, a younger complete stock, 3 by 1·5 cm. } Zool. Dept. 1904. 10. 17. 40.

115. **Porites Great Barrier Reef** $_{(42)}$**22.** (*P. Queenslandiæ secunda et vicesima.*)
(Pl. XVI. fig. 3; Pl. XXI. fig. 11.)

[Thursday Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into a mound with smooth surface and sloping sides, the closely encrusting edges spreading gradually over the substratum, but without any flat basal expansion. The height attained is about 3 cm. for a basal diameter of 5 cm.

The calicles are conspicuous because of the deep central fossa, about 1 mm. in diameter, but varying in size owing to the numbers of intra-calicular buds. The walls are thick, and tend to be built symmetrically—that is, on each side of the primitive wall, which forms a nearly straight median thread-like ridge, crisp, frosted, or echinulated, the septa are joined by stout synapticulæ, which form inner walls. These then make the walls thick and reticular. The septa, with finely echinulate but much interrupted edges, slope rather steeply down towards the small deep central fossa, which is surrounded by two rings of very small echinulate granules, the smaller and more irregular being the septal granules, the larger, the pali. The last-named are usually in the complete formula of eight, but only the four principals show any signs of special development; the rest are not thicker than the rest of the septa. There is no visible central tubercle, and the columellar tangle is deep down and obscured.

The colour of the unbleached coral is rich red-brown.

This is another *Porites* in which the fossa is deep and open, and the pali feebly developed. It grew slightly asymmetrically on a flat stone.

The smooth rounded summit is not in the centre, but on one side. One slope is consequently very steep, and even slightly overhanging; while the opposite side slopes at an angle of 45°. The growth-form may, in fact, be illustrated by fig. 19 on Pl. XIII. The symmetry of the crisp intra-calicular skeleton makes this a beautiful specimen.

a. Zool. Dept. 92. 12. 1. 334.

116. **Porites Great Barrier Reef (42)23.** (*P. Queenslandiæ tertia et vicesima.*) (Pl. XVI. fig. 4.; Pl. XXI. fig. 13.)

[Thursday Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum is massive, and with surface raised sharply into rounded eminences and ridges, with convex depressions or valleys. The edges are closely adherent, and bend under.

The calicles are large, 1·5 mm. and under, nearly superficial and conspicuously polygonal. The wall is a raised, but low, membranous ridge or plate, with nearly smooth edges. Within it and slightly below it is a smooth, continuous flaky shelf separated from the wall ridge by a ring of pores. This shelf can be traced to the septal synapticulæ, and from it rise nearly symmetrically the twelve septal granules, often T-shaped, and only here and there running backwards to join the wall-ridge. From the septal granules very thin, straight septal plates run to join the pali, which rise as high as the wall as a conspicuous ring. The formula is that shown in C, fig. 3. The principals are large frosted granules. The dorsal directive is often a plate.

On the higher parts of the stock the fossa is deep, and the central tubercle sometimes absent. All the characters become more pronounced down the sides.

The section shows developed trabeculæ separated by large round pores, and joined by stout horizontal pieces. The colour of the unbleached stock is sepia.

There are two large fragments which may have been broken from one stock. On the upper part of the stock, according as the central tubercle is absent or not, we have the appearance of a dimorphism, some fossæ showing to the naked eye as deep pin-holes.

The *Porites* which comes nearest to this is that described below—*P. Great Barrier Reef 30.* It is probably a variety.

a, b. Zool. Dept. 92. 12. 1. 349 and 324.

117. **Porites Great Barrier Reef (42)24.** (*P. Queenslandiæ quarta et vicesima.*) (Pl. XVI. fig. 5; Pl. XXI. fig. 14.)

[Thursday Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises originally from an explanate base, whose sharp edges may droop or project a little beyond the base of support. It consists of a continually thickening cluster

of short irregular processes, mammillate, lobate and nodulated, the longer being frequently bent and swollen at the tips. Their thickness is very variable; the largest are 2 cm. They all project irregularly from a solid mass, the surface of which is smooth, or when it runs in between the processes, smoothly convex.

The calicles are slightly depressed on the tips of the processes; on the smooth surface they are quite superficial, and of obscure outline, appearing as irregular star-like arrangements of pores. The walls are thick and flat (except where on the processes they surge up as a delicate flaky reticulum), and covered with a delicate, crisp, almost filamentous tangle of frosted threads and echinulate granules. The septa continue this crisp surface-tissue into the calicle. The septal granules are hardly distinguishable from the wall tissue. The pali are inconspicuous, very variable in number, the four principals alone being well developed. As the columellar tangle and fusions of the septa are deep down, the interseptal loculi are conspicuous at the surface, hence the star-like appearance of the calicles. The fossa is deep and round, but may be obscured by a small tubercle rising from light skeletal threads.

In the younger calicles there is an irregular circular trough between the pali and the septal granules; this makes the calicles conspicuous.

The colour of the unbleached coral is greyish white. The cross section of one of the processes shows a very loose trabecular system, with thin concentric bars.

This may be the same kind as *P. Great Barrier Reef 19*: the growth-form is the same, and the differences in their respective calicles appear slight, but of course with such variable structures the value of the differences cannot be well estimated. The chief difference here seems to consist in the presence of very minute granulations on the surface of the flakes in this specimen. I describe the two separately because of this difference, and because they are from localities fairly wide apart, but the resemblance between their growth-forms is certainly remarkable. This is one of those cases in which it is best to remain on the safe side. It is easy enough—indeed, it saves trouble—to put the two together under one description; but there is no evidence of their specific identity.

The original explanate base of this coral can still be seen; there are several layers, one or the other forming a basal crust, 6 cm. by 4 cm. Above this base the coral expands suddenly into a solid mass, from the top of which the processes rise, tending all to stream one way.

a. Zool. Dept. 92. 12. 1. 360.

118. **Porites Great Barrier Reef** $_{(42)}$**25**. (*P. Queenslandiæ quinta et vicesima.*)
(Pl. XVI. figs. 6, 7; Pl. XXI. fig. 17.)

[Thursday Island, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises as a flat-topped column, thickening as it rises. From the flat top fresh columns rise in clusters, their flat tops fusing irregularly. The separate tiers of columns are 5 cm. high, and the living layer extends about the same distance.

The calicles, 1 mm. in diameter and shallow, are of three kinds, very sharply distinguished from one another. On the level tops they open in a lamellate stroma, the walls being a reticulum, composed of thin, twisted, vertical flakes. The septa and the columellar tangle are also thin plates; there are no granules or echinulæ, and the calicle is flush with the surface. On the sides near the top, the walls are slightly raised, thin, very frosted or echinulate ridges, while the intra-calicular skeleton appears to consist entirely of rather crowded granules, the tips of so many echinulate rods rising up in the fossa. There is a ring of septal granules, sometimes joined on to the wall but mostly separate, and then a ring of pali, the pali being only distinguishable in position and arrangement from the septal granules. They are in a complete formula, B, fig. 3, p. 19. The columellar tangle and the fusions of the septa are all deep down and obscure. The central tubercle is large, and flattened in the directive plane, and reaches nearly to the height of the pali.

On the lower parts of the colony the walls flatten, thicken, and become solid, so that the septal granules appear upon their upper margins, and sometimes seem to send processes over them, giving an occasional appearance of irregular cross striation.

The section shows a thick, very open axial network, as if consisting of filaments, while round this there is a compact layer of delicate radial trabeculæ.

The colour of the unbleached coral is a light dull brown.

This form is interesting, for it is an illustration in the genus of what, in *Goniopora*, I have called the expanding-sheaf method of growth. (See Introduction, p. 22.) The specimen consists of two tiers of columns.

a. Zool. Dept. 92. 12. 1. 341.

119. Porites Great Barrier Reef (42)26. (*P. Queenslandiæ sexta et vicesima.*) (Pl. XVI. figs. 8, 9; Pl. XX. fig. 1.)

[Thursday Island, coll. W. Saville-Kent and A. C. Haddon; British Museum.]

Description.—The corallum forms rounded but flattened clusters of entangled branches, which radiate outwards from a small base of attachment, and fuse, so as to make an almost solid mass with openings into the interior. The round tips of the branches, which are from 1–1·5 cm. thick, project all round freely for varying lengths, 1–2 cm. The living layer extends some 6 cm. down the branches round the periphery of the stock.

The calicles on the upper parts of the stock are conspicuous and deep, especially on the tips of the branches, but in the valleys between these tips they are superficial. They are very variable in size, from 1–1·5 mm., and, where the walls are not surging up, angular. The walls of these angular calicles are mostly very thin and ragged, too irregularly frilled to show more than faint traces of a zigzag; here and there, however, they surge up into a loose filamentous reticulum; it is this which causes the colony to rise into branches, and such calicles are always found on the tips of the branches. The septa are thin and irregular in shape and position; the

septal granules are only here and there traceable, and never form a ring; the pali, on the other hand, form a conspicuous ring of eight small frosted points or plates. The columellar tubercle is small and deep down; the tangle is quite irregular. Down the sides of the branches the whole character of the skeleton changes; the walls and septa are flat elegantly arranged flakes, with frosted edges and surface granules; near the top these granules show signs of forming the thin straggling wall-ridge. The pali gradually increase in size and the flakes get longer, but become less and less conspicuous. Interiorly the flakes spread in a network right across the calicle, just below the pali, to form a conspicuous columellar tangle.

The section of the edge of the incrusting base shows a rather loose arrangement of smooth rounded trabeculæ joined by horizontal elements nearly as well developed as the trabeculæ. The section of one of the rounded tips shows only the earliest traces of trabecular development. The colour of the unbleached stock is a light fawn or brown.

There are two complete stocks and a fragment; the smaller (*a*) probably shows the original stock, and rises 6–7 cm. high from an encrusting base, 4 cm. by 5 cm. across, and with drooping edges. It is not the original cluster itself, for under the base traces of earlier explanate bases can be seen. The specimen is labelled "Thursday Island." *b* is an old stock: the explanate base, with steeply sloping sides, has been left behind, the cluster above it rising into a mass 12 cm. thick and 18 cm. in diameter. The coral is alive for a depth of about 6–7 cm., the lower half of the tangle consisting of dead coral. The dead branches round the stalk-like base radiate outwards almost horizontally (Pl. XX. fig. 1).

This coral is not only interesting on account of its growth, but because of the two types of its calicles, the bulk of them being composed of flattened flakes. From the surface of the explanate base, which is composed of such calicles, small groups of calicles rise up and carry up the colony into vast tangles of branches, and on these upgrowths the calicles have elements which are thin and ragged.

a. Small specimen from Thursday Island (coll. W. Saville-Kent).	Zool. Dept. 92. 12. 1. 139.
b. Large old stock from "Torres Strait" (coll. A. C. Haddon).	Zool. Dept. 97. 3. 9. 220 and 226.
c. A fragment, showing traces of the original branching (A. C. Haddon).	

120. **Porites Great Barrier Reef** (42)**27.** (*P. Queenslandiæ septima et vicesima.*)
(Pl. XVII. fig. 1; Pl. XXI. fig. 15.)

[Torres Strait, coll. A. C. Haddon; British Museum.]

Description.—The corallum is explanate, with thin encrusting edges, rarely free. The middle area of the colony may increase greatly in thickness, and even rise into points and into large excrescences, rounded or angular, with constricted necks, and sometimes up to 4 cm. in height.

The calicles appear as faint concave depressions in the otherwise smooth surface, without sharply defined contours, from 1–1·25 mm. in diameter. The walls, only slightly raised without median ridge, appear as a coarse, granular reticulum, in which, however, traces of a transverse and concentric symmetry of the elements can be seen. An irregular row of echinulate granules occupies the middle line, and on each side of these there are rows of thick, long septal granules which slope down, tapering rapidly into the calicle. These granules seem to be joined together by very fine threads. Below the surface these elements run together to form flakes. The septa consist chiefly of the large frosted or echinulate septal granules which, when longest, appear double, like a wall granule joined with a smaller septal granule, while within these septal granules are the pali, small and not conspicuous; only the four principals are of any size; the palic formula usually seems to be complete, B, fig. 3, p. 19. There is a columellar tubercle, large, echinulate, and ill-defined. The columellar tangle is obscured by the frosted granules, which seem to fill up the fossa.

The section shows a very loose trabecular system. The colour of the unbleached coral is fawn.

There are two colonies on the same mass, which is a crust of dead growths and foreign organisms. The two may have arisen by division of an earlier continuous colony. Encrusting explanate colonies, creeping irregularly over the substratum, frequently break up into patches.

From one of these colonies there rises a rounded knob 2 cm. in diameter, while there is a detached excrescence 4 cm. high with a constricted neck 3 cm. thick. The knob is angular rather than rounded.

a. Encrusting colonies.
b. A detached angular excrescence. } Zool. Dept. 97. 3. 9. 218.

121. **Porites Great Barrier Reef** $_{(42)}$**28.** (*P. Queenslandiæ octava et vicesima.*)
(Pl. XVII. fig. 2; Pl. XXI. figs. 18, 19.)

[Torres Strait, coll. A. C. Haddon; British Museum.]

Description.—The corallum is explanate and thin, and closely encrusting; the edges bending sharply under for 1–2 cm. and closely adhering. The upper surface is very wavy. These irregular encrusting colonies may form knobs and globular masses also with wavy surfaces.

The calicles are conspicuous and deep, often 1·5 mm. in diameter. The walls surge up and have rounded tops of a light, ragged reticulum. The septa slope downwards and end in a rather large complete ring of eight small pali, which is, nevertheless, very inconspicuous. The large deep interseptal loculi are often gashed back rather far into the reticular wall. The columellar tubercle is deep down in the large open fossa.

The colour of the unbleached coral is dark grey-brown. The vertical section shows a loose irregular trabecular system with tabulæ very near the surface, so that the living flesh penetrates but a short way (1·5 mm.) into the corallum.

This last fact may be correlated with the depth of the open cup-like calicle. In forms in which the intra-calicular skeleton is flush with the surface, the living matter penetrates 4–5 mm.

There appear to be two specimens. The explanate colony is only a fragment, looking as if broken from the edge of a larger stock. The deep folding under its edge is an interesting point, and seems to show that the real method of growth is quite irregular, and that it may form explanate sheets which crumple and fold, or it may be piled up into mounds which by the folding under of the edges may build up nearly globular masses. This reasoning seems to justify me in grouping with this irregularly explanate stock a round stalked knob, with traces of explanate portions round the stalk. But the real similarity between the two lies in the calicles, which are built on exactly the same plan. In this stalked globular mass the walls at the top surge up a little more fully, and the filamentous reticulum is thicker and a little more delicate.

The fig. 2 (Pl. XVII.) of the magnifications is from this globular form.

a. An irregular explanate fragment. Zool. Dept. 97. 3. 9. 227.
b. A globular mass. Zool. Dept. 97. 3. 9. 59.

It is worth noting that the next form has calicles which are but variations on this same type. But what the real relationships between them are, we have no means of ascertaining. They may all be the same coral.

122. Porites Great Barrier Reef (42)29. (*P. Queenslandiæ nona et vicesima.*)

(Pl. XVII. figs. 3, 4, 5; Pl. XXI. fig. 21.)

[Torres Strait,* coll. H.M.S. 'Alert,' W. Saville-Kent, and A. C. Haddon; British Museum.]

Description.—The corallum rises into a smooth, rounded nodule; if it settles upon a loose object, it soon falls over and becomes free; if on a fixed object, it gradually expands to form a thick, flat-topped, mushroom-shaped mass, which dies down on the top, while its pendent edges hang down round a thick stalk of attachment; the different growth-edges are closely adherent, never free. The surface seems unable to live for more than 1 cm. under projecting sides of the mass.

The calicles are distinct depressions, but vary in size from slightly over to slightly under 1 mm., although the variations in this respect appear greater than they really are because of the much greater variation in the thicknesses and slopes of the walls. These walls on each side of their middle ridges are built of the peripheral ends of the septa, joined by a zigzag

* The specimen (*h*) collected during the voyage of H.M.S. 'Alert' is recorded as from the "N.E. Australia." That (*c*) collected by Mr. Saville-Kent is labelled only "Great Barrier Reef." All the rest are from Professor Haddon's collection, and are labelled "Torres Strait."

arrangement of synapticulæ, and tending to develop into a stout, rather stiff reticulum, sometimes of flakes with rounded pores. But the characteristic of the coral is that the middle ridges of these walls are a fine, irregular, filamentous reticulum. It is the variations in the thickness and degree of development of this spongy ridge which give all the different appearances to the individual corals (see the figures and the descriptions of the specimens).

The septa appear to be laminate and very porous, so that their edges are much broken. They have echinulate or very roughened sides, and, seen from above, often appear bent. The pali are small, but usually form a complete ring (formula B, fig. 3, p. 19), and rise from a columellar tangle which frequently shows as a ring joined by radii to a central axis. This rises as a tubercle, but remains below the level of the pali.

The section shows very loose, rather thin trabeculæ, the horizontal elements not forming definite continuous tiers, as is most commonly the case. The colour of the unbleached coral is a light shade of sepia.

I have grouped eight specimens under this heading because they all show essentially the same method of growth, and have calicles which seem to have the same principle of wall formation, although the variations in this respect, and consequently in the aspect of the surface, are very great.

Two of them, *a* and *b*, are mushroom-shaped; *c* has the under surface of the rounded head just beginning to leave the stalk, or to use a simile from the mushroom, just beginning to rupture the velum.

a. (Pl. XVII. fig. 3.) The top of this mushroom-shaped stock has died down and become a settling place for Serpulids. The calicles are conspicuous though small owing to the thickness of the walls, the tops of which are a rather close filamentous reticulum.

Zool. Dept. 97. 3. 9. 223.

b. (Pl. XVII. fig. 4.) This differs in the fact that the walls are thinner. It is possible to see in this merely a more rapid growth. The top of this much smaller stock was also killed down, and also beset with Serpulids. Zool. Dept. 97. 3. 9. 222.

c. Is a large specimen, labelled only "The Great Barrier Reef," but from its habit it clearly belongs to this series. It apparently rolled over several times, and thus now has no regular stalk, but grows sideways upon a free mass made up of former growths.

Zool. Dept. 92. 12. 1. 560.

d. Is a rounded knob on a stalk, which is mainly rotten coral. Zool. Dept. 97. 3. 9. 221.

e. Is growing from the end of a free mass, apparently made up of overturned previous growths. Zool. Dept. 97. 3. 9. 225.

f. (Pl. XVII. fig. 5.) Is a free mass, with some calcareous algal concretion occupying the place where the stalk should be. This one has the calicles typical of *a* (see Pl. XVII. fig. 3), over one part, while those in what appears to have been its upper surface are shown in Pl. XVII. fig. 5. This is a striking example of the variations in aspect of calicles due to accidental circumstances. My experience leads me to believe that flattened walls showing a great deal of delicate skeletal proliferation are frequently due to the proximity of some foreign body disconcerting the growth and functions of the polyps. Zool. Dept. 97. 3. 9. 215.

g. Is a free nodule, with the top of a previous growth protruding between the edges of the living colony where the stalk ought to be. Zool. Dept. 97. 3. 9. 216.

h. A rounded nodule, with edges creeping (some under, some outwards) over the irregular mass of rotten coral which formed the substratum. Zool. Dept. 82. 2. 23. 148.

123. **Porites Great Barrier Reef** $_{(42)}$**30.** (*P. Queenslandiæ tricesima.*)
(Pl. XVII. fig. 6; Pl. XXI. fig. 22.)

[Torres Strait, coll. A. C. Haddon; British Museum.]

Description.—The corallum forms thick flattened cakes of irregular outline, running out here and there into large rounded lobes. The surface is nearly smooth, but with a few slight concave depressions, quite irregular, and forming no system of valleys.

The calicles are polygonal, large, 1·25 mm., flush with the surface except for a thin raised wall, which forms a sharp reticular pattern over the whole surface. The wall is a low membranous thread, very echinulate and generally straight, the irregularities not showing any zigzag pattern. There are no traces of an inner synapticular wall at the surface, although deep down they can be made out; the septa are long and straggling, very thin, slightly bent, and here and there thickened by lateral echinulations. These irregular thickenings occasionally appear as a ring of small septal granules halfway between the wall and the pali. This ring, indeed, becomes conspicuous on the lateral calicles where the skeletal elements are all thicker and the skeleton itself more compact. The pali form rather a large ring of eight very frosted granules or plates, which rise from a light reticular tangle, with a flattened central tubercle. The lateral calicles are very symmetrical and compact arrangements of neat rings of large frosted granules, which are the tips of stout trabeculæ, with small intervening pores.

The colour of the unbleached coral is an ash-grey.

There is one specimen with a peculiar cake-like growth. For some time I hesitated as to whether this might not be a variety of *P. Great Barrier Reef 23.* But the complete absence of any inner synapticular ring forming a second wall, and the difference in growth-form, compels me to keep them separate. They have, however, the shallow polygonal calicles, with raised thread-like wall and central boss of pali, in common.

a. Zool. Dept. 97. 3. 9. 224.

124. **Porites Great Barrier Reef** $_{(42)}$**31.** (*P. Queenslandiæ prima et tricesima.*)
(Pl. XVII. fig. 7; Pl. XXI. fig. 20.)

[Torres Strait, coll. A. C. Haddon; British Museum.]

Description.—The corallum rises from a small initial colony, about 2·5 cm. in diameter, into a smooth rounded mass, the calicles in the vertical section spreading out in a wheat-sheaf arrangement.

The calicles appear very small, under 1 mm., flush with the surface, or very slightly depressed, and angular. The walls show a faint indication of being raised; on the top surface they are in complete rows of very delicately jagged or frosted granules, allowing free communication between adjacent interseptal loculi; round the lower sides they consist of delicate flat flakes perforated in single or double rows, and with delicate frosted granules scattered over them; they are thus reticular. The septa are rendered conspicuous by their pronounced lateral echinulations. The echinulæ may be grouped so as to form both wall granules and small septal granules. Within the angular areas between the slightly raised polygonal walls of the calicles, and the circular fossa, the septa seem to rise from shelves of flat flakes. The pali, very echinulate or frosted, are usually present as the five principals, with the dorsal directive sometimes added as a small plate or knob. The central tubercle is mostly conspicuous as a round or flattened granule on a level with the pali, or else it is quite absent, leaving a pin-hole fossa.

The section shows long regular trabeculæ, not very crowded, joined together very irregularly in the central axis of the stock, but more regularly and with stouter elements down the sides.

The colour of the unbleached stock is a pale brown.

The photographic magnification shows the top ridges of the walls and septa very clearly, owing to the fact that the specimen was lighted from the side. In reality the specimen looks white and solid, seen from above, with no such deep interseptal loculi as shown in the photograph.

This is a very instructive specimen. It has been fractured so as to show part of the epithecal film of the original colony, a vertical section through the stock, and also the fact that at one period the surface had been largely killed down and was grown over by a fresh layer, the rapid thickening of which can be readily seen. Important, also, is the fact that the internal texture varies, for in the central axis where growth is most rapid, the trabeculæ are loose and long, and very irregularly joined by horizontal elements; but down the sides the texture is more compact, and the two elements are more equally developed.

The echinulation of the surface elements gives the coral a kind of bloom, which recalls the somewhat similar type of calicle of *P. Bay of Panama 1.* (See Pl. X. fig. 3.)

a. Zool. Dept. 97. 3. 9. 217.

No. 37 ought to have been described here. It is, however, associated below with Nos. 35 and 36, on account of the character of the growth-form.

The occurrence of a large stag-horn shaped *Porites*, 4 to 5 ft. high, on the steep edges of reefs in the Torres Strait, is mentioned in a footnote on p. 117.

GREAT BARRIER REEF—NO DEFINITE LOCALITY.

All the forms which follow, except No. 37, were labelled "Great Barrier Reef," without any more definite locality. Had such been given, it might in a few cases have been possible to assign them places near some one of the foregoing.

No. 37 is from the "Gulf of Carpentaria—Great Barrier Reef," and should have been placed with those from the Torres Strait. I have, however, placed it near Nos. 35 and 36, because the growth-forms, though not exactly alike, are yet similar kinds of departures from the usual explanate, massive, or branching.

For instance, the specimen registered as No. 92. 12. 1560, is so exactly like the group from the Torres Strait, here recorded as *P. Great Barrier Reef 29*, that I have not hesitated to place it with that group.

125. **Porites Great Barrier Reef** $_{(42)}$**32.** (*P. Queenslandiæ secunda et tricesima.*)
(Pl. XVII. fig. 8; Pl. XXI. fig. 23.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum appears to creep in layers of varying thickness—1 mm. at the edges—irregularly over the substratum, sometimes forming hollow or solid knobs, perhaps in association with worm-tubes. The surface of the knobs may be smooth, or raised into irregular points.

The calicles show very great variations in different parts. They are open, conspicuous, definitely sunk without being deep, sub-circular, or circular on smooth surfaces where the walls are thickened, but very angular on rougher places; they average 1 mm. in diameter. The wall varies greatly in thickness. Typically, there is an elegant reticular ridge resting upon a more solid, sometimes strikingly flaky substructure. The variations in size and aspect of the calicles depends upon the development of the reticular ridge. It is sometimes a straggling row of narrow, elegant, spiky flakes with echinulate knobs, which may sometimes run as striæ transversely across the wall. At others, as in Pl. XVII. fig. 8 (from specimen *b*), these flakes are so developed as to make the calicles deep and cylindrical.*

The septa are well developed, with a strong tendency to slant from the wall as flakes, sometimes very broad and rounded towards the fossa. From here they thin very rapidly, so as to leave wide interseptal loculi, and join a pronounced columellar tangle. All the elements

* The appearance is as if the coral had here come against some obstruction. A proliferation of reticular elements is a common effect produced in growing corals when approaching too near a foreign body.

are echinulate. The pali rise nearly to the height of the wall, and vary greatly in size among themselves. The five principals and the dorsal directive are usually large and echinulate; the usual three ventrals are frequently very minute.

A central tubercle may be found either well developed and high, or very small and deep down among the strands of the conspicuous tangle of the columella, or absent altogether, the fossa being deep and open.

The colour of the unbleached coral is a greyish brown, the grey being due apparently to a kind of bloom from the echinulation of the elements (not, however, anywhere seen). The section shows a probably unique arrangement of trabeculæ. They are thin and very loose, but at very uneven distances apart, frequently with large rounded pores between.

There are two specimens, both knobs built up by irregular incrustations; several superimposed colonies can be traced by their broken edges. In both are traces of other organisms distorting the coral, sponges (*clione*), worms, etc. The calicles vary so greatly that we have almost every gradation between the extreme shown in the figure, and the flaky kind which superficially reminds us of the calicles of *P. Singapore 7*.

a. Pl. XXI. fig. 23. Zool. Dept. 92. 12. 1. 530.
b. Pl. XVII. fig. 8. Zool. Dept. 92. 12. 1. 549.

A third specimen may, perhaps, be seen in *P. Great Barrier Reef 39*. The calicles resemble one another, and the fact that this last-named coral encrusts a long worm-tube is quite in keeping with the observation above made as to the infesting of this growth with foreign organisms.

126. **Porites Great Barrier Reef (42)33.** (*P. Queenslandiæ tertia et tricesima.*) (Pl. XVII. fig. 9.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum appears to form an irregular rounded knob, with slightly wavy or indented surface. If the knob falls over, fresh incrustations or knobs appear on the sides. The edges of the colony are closely adherent.

The calicles are shallow and small, mostly under 1 mm. in diameter. The walls vary in thickness according as they are on elevations or in depressions. There is a strong tendency to form a fine, sometimes incomplete, zigzag median ridge, which may be observed when a stout granular reticulum appears. The septa are regular, and have large septal granules, which in some lateral calicles may fuse just below the surface to form a stout inner wall within a thin, raised, very zigzag median ridge.

The pali appear in formula E fig. 3, (p. 19), the four principals showing a trace of being V-shaped, and the ventral triplet forming a trident. The pali rise as a central boss, conspicuous to the naked eye. The central tubercle is a frosted granule, sometimes joined on as the handle of the trident. The granules are everywhere finely frosted.

The colour of the unbleached coral is a light brown. The section is somewhat dense, and built of thick trabeculæ compactly arranged.

The single specimen may, perhaps, be another of the group here described under Nos. 28 and 29. The growth-form may, perhaps, agree, but the calicles differ, as may be seen from a comparison of the figures Pl. XVII. figs. 2–5 with fig. 9. There is not much trace of the tendency to form a filamentous top to the wall, for, as stated, there is mostly a median ridge.

a. Zool. Dept. 92. 12. 1. 516.

127. **Porites Great Barrier Reef** $_{(42)}$**34**. (*P. Queenslandiæ quarta et tricesima.*)
(Pl. XVIII. fig. 1.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum is a smooth, nearly perfectly oval mass, attached by a small oval base. The adherent edge bends smoothly under all round as far as the base. There is no evidence of there having been any stalk formation.

The calicles are rather large, 1·5 mm., conspicuous because deep, and very sharply angular; the walls are simple, straight, fenestrated, and with granular rather than denticulate edges. The septa are stout and with very granulated sides, so as nearly to fill the base of the calicle. They appear as irregular thickenings of the walls round the aperture, and these give the wall-edges the peculiar ragged appearance well shown in the figure. They only project deep down in the fossa. The ring of pali which rises from them is large and tall, reaching almost to the height of the wall. They are in a complete number. The central tubercle is thin and flattened in the directive plane; it rises nearly as high as the pali.

The colour of the unbleached coral is a rich reddish brown. The section of the base shows a regular arrangement of radiating trabeculæ, stout and closely packed.

There is only one specimen of this *Porites*, which appears to be quite unique in the character of its walls.

a. Zool. Dept. 92. 12. 1. 515.

128. **Porites Great Barrier Reef** $_{(42)}$**35**. (*P. Queenslandiæ quinta et tricesima.*)
(Pl. XVIII. fig. 2; Pl. XXI. fig. 24.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum towers up into stout tapering columns of very irregular transverse outline, the sides being knobbed or with vertical ridges some 1–1·5 cm. high on a column 5–6 cm. in thickness. The living layer is at least 9 cm. deep, and the lower edges creeping but not always closely adherent.

The calicles are everywhere superficial, so that the surface is smooth; they vary in size, averaging 1 mm., with a good many double calicles. The walls are simple, very thin, zigzag,

and often incomplete, with pointed angles. The septa have the same character as the walls, their edges being bent and slightly granulated. The pali are small, and not conspicuous, in formula Diagram B, fig. 3, p. 19, but with the palus on the ventral directive outside those of the two other members of the triplet (perhaps a septal granule, cf. formula H, fig. 3). The interseptal loculi are open and conspicuous; a central granular tubercle rises up in the fossa frequently as an axial strand of a columellar tangle.

The texture of the vertical section is regularly and somewhat closely trabecular with sub-circular pores. The colour of the unbleached coral is ash-grey at the immediate surface, but the section shows a greenish layer about 1 mm. below it.

The irregular columnar growth of this coral is interesting, especially so when compared with that of the next two, Nos. 36 and 37, the latter coming from the Gulf of Carpentaria. All these contrast greatly with all the other known Great Barrier Reef forms.

a. Zool. Dept. 92. 12. 1. 536.

129. **Porites Great Barrier Reef** (42)**36**. (*P. Queenslandiæ sexta et tricesima.*)
(Pl. XVIII. fig. 3; Pl. XXI. fig. 25.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into a massive irregular ridge or crest, thickening as it rises, being 4–5 cm. thick when some 7 cm. high; the living layer is 5 cm. deep. The top is broken up into deeply lobed longitudinal and transverse ridges.

The calicles are small, under 1 mm., and only slightly pitted. The walls vary in thickness, either as single straight rows of finely frosted granules, or as thick low ridges with sloping sides, and as if composed of similar granules with minute pores or spaces between. The septa are thick where they run into the wall, and the narrow interseptal loculi are gashed back far into it. Their finely frosted thickenings are the septal granules, sometimes distinguishable as such. They are separated from the pali, which are large, similarly frosted granules. These two sets, together with the large oval central tubercle, over the greater part of the stock, seem to fill up the whole fossa, making the corallum dense. The pali, which hardly rise above the level of the septa, are in the complete formula B, fig. 3, p. 19; the principals and dorsal directives are large. The central turbercle rises to nearly the same height as the pali.

The section is compact and trabecular, but the trabeculæ are not so close as the surface aspect of the coral would lead one to think. The colour of the unbleached coral is a pale fawn yellow.

This is another *Porites* with an amorphous growth-form, similar to those of Nos. 35 and 37, on which see the observations. Several worm-tubes run somewhat superficially through its substance, a factor which may have had some influence on its form.

a. Zool. Dept. 92. 12. 1. 529.

130. **Porites Great Barrier Reef** $_{(42)}$**37.** (*P. Queenslandiæ septima et tricesima.*)
(Pl. XVIII. fig. 4; Pl. XXI. fig. 26.)

[Gulf of Carpentaria, Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into a tall, stout, erect plate, of varying thickness from 1–3 cm. thick, the variations being due to the waviness of its sides. It widens as it rises, being 7 cm. across when 11 cm. high. Rounded and constricted knobs spring from its top and lateral edges, the knobs being compressed in planes parallel to the plane of the plate. The living layer extends at least 11 cm.

The calicles are all flush with the surface, varying greatly in size, but mostly under 1 mm. The walls appear rather thick, but can mostly be analysed into a very pronounced zigzag thread, the points running into the calicle as short portions of septa. The zigzag may be so pronounced that the septa appear almost to striate the wall transversely, and the wall looks frequently incomplete, adjacent interseptal loculi communicating between these transverse septal ridges. Beneath the surface the walls appear flaky. The septa show a ring of septal granules frequently hardly separated from the walls, and a ring of not very conspicuous pali; the five principal pali are constant, but almost every possible variation occurs in the appearances of the elements of the triplet. The columellar tubercle is thin and flattened. These elements do not fill the calicle aperture, and the dark spaces between them make the calicles conspicuous.

The section shows the trabeculæ as thin and regular, and about their own width apart.

The colour of the unbleached coral is an ash-grey, which penetrates 2 mm.

There is only one specimen of this coral, which should have been placed among the forms from the Torres Strait. It is placed here in association with forms Nos. 35 and 36 on account of its method of growth. Although I do not mean to imply that these latter forms came from the same place or are in any way related, still it is interesting from a comparative point of view to emphasise these departures from the more common explanate, massive and branching forms. The specimen has a faint superficial resemblance to a frequent form assumed by *Heliopora*.

a. Zool. Dept. 92. 12. 1. 534.

131. **Porites Great Barrier Reef** $_{(42)}$**38.** (*P. Queenslandiæ octava et tricesima.*)
(Pl. XVIII. fig. 5; Pl. XXI. fig. 27.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The form of the corallum is unknown. The single specimen is a tongue-shaped fragment, nearly 5 cm. long, 2·5 cm. in diameter, and tapering to a flattened tip 1·5 cm. broad and 0·5 cm. thick, the tip being rounded off.

The calicles are polygonal, conspicuous, and deepened, about 1 mm. in diameter. The walls are simple, straight, and appear, from above, like rows of granules which are the tips of

trabeculæ; seen from the side, they are fenestrated. The septa start rather deep down beneath the top edges of the wall, but rise to form a rather uncertain ring of small septal granules, within which ring, the tall, rod-like pali rise as a conspicuous oval ring, in complete formula B, fig. 3, p. 19. The elements of the triplet are smaller than the principals, but arranged symmetrically on the oval. The columellar tubercle does not rise to the height of the pali, and is a little obscure, but is mostly flattened, and sometimes divided into two. The interseptal loculi are deep and conspicuous when the calicle is looked at from above, but the frosted sides of the septa prevent them from being large.

The cross section shows a very regular and rather close trabecular system. There is a lamellate axial reticulum, which appears at the tip in calicles of the well-known type, cf. Pl. XVI. fig. 6 (*P. Great Barrier Reef 25*). The colour of the unbleached coral is brown.

This, unfortunately, is only a fragment.

a. Zool. Dept. 92. 12. 1. 559.

132. **Porites Great Barrier Reef (42)39.** (*P. Queenslandiæ nona et tricesima.*)
(Pl. XVIII. fig. 6; Pl. XXI. fig. 28.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into an erect thin column, with a worm-tube* in its axis. Short, thick, scale-like knobs, rounded at their tips, cover the sides irregularly, the apex of the column being a knob 1·5 cm. in diameter. The column is 9 cm. high, and 3 to 3·5 cm. thick.

The calicles are conspicuous, deepened, sub-circular, only crowded when they open in the reticular cœnenchyma at the apex round the worm-tube, slightly over 1 mm. in diameter. The walls round the tip are tall, ragged, very thin and reticular, the reticulum being lamellate or flaky, the flakes being mostly vertical and fenestrated. Lower down the walls gradually thicken, till near the base they are nearly 1 mm. across, and the reticulum is close, consisting of horizontal flakes, with a top edge of filamentous network; in this a zigzag median thread may sometimes be recognised, but it is more often irregular, and the ends are mostly crisp echinulate granules, which are entirely absent from the lamellate skeleton at the apex of the column. The septa project at various levels down the sides of these walls; they are short and crisp; the septal granules are for the most part involved in the wall reticulum, but are frequently recognisable. The ring of pali, which are tall ragged spikes, is very large owing to the shortness of the septa. The formula is usually complete. The columellar tangle is large, with pores in it nearly as large as the interseptal loculi, which are very open. A central tubercle rises nearly as high as the pali.

The section shows a radial arrangement of trabeculæ, which are stout, but wide apart. There are great numbers of tabulæ, but no conspicuous development of an axial reticulum round the central worm-tube. Not only at the apex, but also at the tips of each of the lateral

* The worm-tube is 2 mm. wide below, and nearly 4 mm. at the top, and open throughout its length.

knobs, the smooth lamellate reticulum appears in which the calicles open almost free of all crispness, echinulation or granulation.

The colour of the unbleached coral is brown.

There is one specimen. The presence of the worm-tube running regularly up the axis of the column is interesting. It is impossible to say whether this is a normal symbiosis or purely accidental, and if the latter, how many of the characters of the coral are due to the presence of the worm, or what the coral without the worm would be like. There is a distinct resemblance of the calicles to those of *P. Great Barrier Reef 32*, which, as noted, was much infested with foreign organisms, and it is quite possible that this is simply an outgrowth of that form encrusting a long worm-tube.

a. Zool. Dept. 92. 12. 1. 547.

133. **Porites Great Barrier Reef** (42)**40**. (*P. Queenslandiæ quadragesima.*)
(Pl. XVIII. fig. 7; Pl. XX. fig. 3.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum, swelling above its base, rises into what appears to be an irregular cluster of fused moniliform columns, although there are no free columns at all, but rather flabellate plates, with upper edges and sides broken up into knobs or nodules of different sizes, from under 1 cm. in diameter to 2 cm. long and 1·5 cm. broad, often pointed at their tips or ovate; the living layer is 9 cm. deep.

The calicles are of all sizes, up to 1 mm., without definite shape, shallow-depressed, except on the tips of knobs, where they are deeper and funnel-shaped. The walls are irregular, simple, very thin, sharp and tall on the tips of the knobs, but elsewhere thicker and frosted, and looking as if composed of stout, narrow flakes immediately below the straight frosted edge. They may form a shelf, sometimes with pores in it, so as to suggest an inner synapticular wall. These flakes are the bases of the septa, which are short, stout, bent, and crisp. The pali form a very irregular ring of crisp rods of different sizes, that in the dorsal directive is often absent, and those of the triplet are usually separate and variously developed.

The columellar tubercle is small and deep down, as an axial strand of the ring-like columellar tangle and attached to the ring by radial bars.

The section shows trabeculæ far apart and so irregular as frequently to be incomplete, that is, they may suddenly bend on one side and end.

The colour of the unbleached coral is a brown, suffused at the tips with pink, over all the rest with a rich green. This green persists beneath the surface, as is seen in the section even of the bleached parts.

This coral reminds one in its colouring of the forms *P. Great Barrier Reef 4*, from Capricorn Islands, *6* from Palm Island, and *16* from Rocky Island, with which it may be profitably compared. I can, however, discover no special point of similarity with any one of these in particular, which would lead me to suggest a more definite locality for this coral.

a. Zool. Dept. 92. 12. 1. 577

134. **Porites Great Barrier Reef** $_{(42)}$**41**. (*P. Queenslandiæ prima et quadragesima.*)
(Pl. XVIII. fig. 8; Pl. XX. fig. 4.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into flattened fan-shaped plates, the edges of which divide into rounded or flattened lobes, which bend into different planes, until compact clusters are formed with a solid centre, from which short forking processes and cockscomb-like plates project in all directions. The flattened lobes, with undivided edges and constricted necks, may be 3 cm. high, 3 cm. broad and 0·75 cm. thick, with divided edges 3·5 cm. high, 4 cm. broad. The living layer is 6 cm. deep.

The calicles are flush with the surface, from 1 to 1·3 mm. in diameter. The walls are narrow and flat-topped, raised slightly above the surface only near the tips of the stock. In texture the wall shows a surface layer of very branching granules spreading along the top, but not throwing up ragged ends; these rest upon a nearly solid flat surface with small pores. The septa are conspicuous, very echinulate, and show a fairly regular ring of septal granules only slightly separated from the walls. Within this is the ring of pali, which are usually in formula Diagram C, fig. 3, all but the dorsal directive being large frosted granules. The central tubercle is a small granule rising nearly to the level of the pali, and joined just below the surface by rays to the ring of pali.

The section shows a very large meshed axial lamellate reticulum, which comes to the surface at the tips of processes and edges of the flabellate lobes as a tangle of so many vertical plates in which calicles appear. Round this the trabeculæ are regularly and radially arranged at even distances apart, and all ending in blunt points at the surface.

The colour of the unbleached coral is a bright reddish-brown.

This is a very singular method of growth. The original flabellate stock can hardly now be traced, as the stalk of the whole has apparently been secondarily thickened.

a. Zool. Dept. 92. 12. 1. 409.

135. **Porites Great Barrier Reef** $_{(42)}$**42**. (*P. Queenslandiæ secunda et quadragesima.*)
(Pl. XVIII. fig. 9; Pl. XX. fig. 5.)

[Great Barrier Reef, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises from a small explanate base, 1·5 cm. in diameter, into small flattened knobs, probably only slightly constricted; these proliferate until a stalked cluster of short, blunt, usually flattened processes, from 1 to 1·5 cm. long, radiate outwardly in all directions from a central mass, which, in the first instance, represented the secondarily thickened original knob. In old stocks these clusters spread out and break up into separate secondary clusters. The living layer of a cluster is about 4·5 cm. deep.

The calicles are small, uniformly about 1 mm., crowded, polygonal, and superficial. The walls are a thin, slightly raised ridge, tracing a low network over the surface. They consist of

straggling rows of small granules or flakes standing upon a solid-looking flat surface formed apparently by the flaky bases of the septa. Round the edges of the shelf thus formed occurs the ring of rather large septal granules, and within this ring the compact ring of five pali, viz. the four principals and the palus formed by the fusion of the ventral triplet (see Diagram F, fig. 3, p. 19). The central tubercle either nearly fills the small ring of pali as a flattened oval, or else is a minute granule, or may be altogether absent. The section shows the trabeculæ hardly better developed than the concentric elements, both together making a rather loose, open, somewhat irregularly retangular network, with large open and rounded meshes. The colour of the unbleached stock is reddish-brown.

The single specimen shows an old cluster, upon which three clusters have developed nearly separate from one another. There is also, fortunately, a quite young colony, which shows the method of starting. The colour is like that of the last described form, but both method of growth and calicle formation are quite different.

a. Zool. Dept. 92. 12. 1. 510.

NORTH-EAST AUSTRALIA.

136. **Porites North-East Australia*** $_{(2)}$**1.** (*P. Australiæ Aquilonaris prima.*)
(Pl. XXII. fig. 1.)

[North-East Australia, coll. H.M.S. 'Alert'; British Museum.]

Description.—The corallum is a sub-globular mass, with thin, closely adherent edges, which creep under the stock. The stalk seems to be composed of the rotten remains of much smaller, earlier globular growths.

The calicles are very small, and apparently very irregular, often stellate, and from 0·75 to 1 mm., mostly inconspicuous, but with scattered individuals very conspicuous on account of having deep, open fossæ. The walls are built of a stout, close reticulum, with rounded pores, here larger, making the network more open, and there very small, making it appear nearly solid. They are rather flat-topped, and descend deeply into the calicles. The septa are short, rather thin and frosted, and slope as jagged plates from the top edge of the wall. They very seldom meet, and the only traces of pali where the septa do not meet are the innermost highest points of the jagged septal edges. From these pali the septa descend vertically round the fossa, which varies in size, is always deep, at times with a floor of close reticulum, at others without any such floor visible. Owing to the fact that the septa are thin, and do not meet, the interseptal loculi are conspicuous, and, seen from above, make the often inconspicuous calicles star-like.

There is only one specimen. The colour of the unbleached coral is a greyish-brown.

a. Zool. Dept. 82. 2. 23. 171.

* On this region see remarks on p. 109.

137. **Porites North-East Australia** $_{(2)}$**2.** (*P. Australiæ Aquilonaris secunda.*)

[North-East Australia, coll. H.M.S. 'Alert'; British Museum.]

Description.—The corallum forms a small knob, enveloping the mouth of a spiral worm-tube, without closing the aperture; edge closely encrusting. The worm-tube adheres to the tip of a fallen stem of *Madrepora*.

The calicles are about 1·5 mm., shallow funnel-shaped. The walls have a median ridge, from which the septa slope gradually down to the small central fossa. The texture of walls and septa seem to consist of very stout trabeculæ, which end at the surface in large, irregular granules, which stand up all over the surface. There is a row along the ridge of the wall, and though somewhat irregularly, a row of wall granules, inside which is a ring of smaller septal granules, and, still further in, a ring of four principal pali. The septal granules seem in this case to serve for the *four* smaller pali (cf. E, fig. 3, p. 19) which are hardly raised, and are inconspicuous. The fossa is shallow, and has an inconspicuous central tubercle. The whole texture of the surface is very coarse.

There is only one small colony with smooth round surface, 1 cm. across and 1·5 cm. long. It may be too small to show the adult characters, but the calicles have very distinctive structural features.

a. Zool. Dept. 82. 2. 23. 140.

One other coral from the same collection, made by H.M.S. 'Alert,' and from the same locality, appears to be "specifically" identical with the forms here called *P. Great Barrier Reef 29*, most of which come from the Torres Strait. It seems not improbable that the two specimens just described may also be from that same locality.

NORTH AUSTRALIA.

138. **Porites North Australia** $_{(8)}$**1.** (*P. Australiæ Borealis prima.*) (Pl. XXII. fig. 2; Pl. XXIV. fig. 1.)

[Port Essington, coll. J. B. Jukes; British Museum.]

Description.—The corallum rises as an open cluster of short, thick, flattened processes curving upwards from a widely creeping base (which probably envelops a prone previous growth). The processes, or thick branching stems, are 4–5 cm. high, and from 2–3·5 cm.

wide at the base, and about 1 cm. thick. They are smooth, and the tips swell and divide into uneven halves. It looks sometimes as if the main stem grew on and threw off smaller branchlets first on one side then on the other. The branchlets are short, constricted knobs, with stalks about 1 cm. thick.

The calicles are superficial, or slightly pitted, about 1 mm. in diameter. The walls are wide and solid looking, being built up of horizontal feathery flakes, on the tops of which are thin, straggling granules or threads, which are the beginnings of another layer of flakes. These give the surface a velvety appearance.

The septa are wedge-shaped tongues of thin flakes, with feathery granules along their top edges, often continuous with the fine threads on the wall. These show a ring of small septal granules, not sharply marked from the wall by any circular furrow. The pali, which are small, feathery or frosted, form rather a large open ring, showing the complete formula H, fig. 3. A feathery and often flattened tubercle rises in the fossa to near the surface.

The section shows the horizontal and radial trabecular elements about equally developed.

This coral was named *Synaræa* * *dilatata* by Brüggemann in his MS. Catalogue; he gave no description, but labelled the specimen "Type of Species."

A comparison between this coral and *P. North Australia 7* (Pl. XXII. fig. 8, Pl. XXIV. fig. 6) shows some resemblance between their calicles and their methods of growth. But, though the peculiar manner of forking is seen in both, the stems or processes in this coral are very massive as compared with those of No. 7. They may be safely regarded as varieties of the same kind of *Porites*.

a. Zool. Dept. 46. 7. 30. 24.

139. **Porites North Australia** $_{(8)}$**2**. (*P. Australiæ Borealis secunda.*)
(Pl. XXII. fig. 3; Pl. XXIV. fig. 5.)

[Port Essington, coll. W. Saville-Kent; British Museum.]

Description.—The corallum rises into round stems which flatten and divide. An old stock may consist of a cluster of such stems springing from the surface in an irregular ring round a thick flattened stalk (a former stem). All show a tendency to flatten, but some have attained a greater width than others. Round bases of stems are from 1·5 to 2 cm. thick, and widths of flat tops from 3–7 cm. The widest not only fork in, but also at right angles to, the plane of greatest width. The depth of the living layer is 10 cm. and more.

The calicles are all flush with the surface, variable in size up to 1·5 mm. The walls are flat, nowhere thick, but rise into slight ridges on the tips of stems and in sheltered valleys. They consist of rough frosted granules, the tips of trabeculæ, mostly arranged in single rows between the calicles. The intra-calicular skeleton seen at the surface is also a mosaic of similar

* On this generic name compare the Introduction, p. 9.

granules joined together by narrow waists, which show the typical skeleton of *Porites*. The ring of septal granules is separated from the wall by a narrow inconspicuous circular furrow. The pali are slightly larger, but are not raised. The usual formula consists of the five principals, but occasionally that of the dorsal directive is pushed in far enough to make the ring six instead of five. The central tubercle is large, often flattened, and rises to very near the surface. Round the base of the stock all these granules are larger, and become so compact that the surface is smooth and velvety and the calicles disappear from the unaided vision, and are only distinguishable under a lens by the arrangements of the granules.

The section shows a strong development of the trabeculæ, but with some irregularity in their distances apart, some of the intervening pores being very small, others very large.

The colour of the unbleached coral is dark reddish-brown.

This coral has exactly the structure of calicles seen in many another branching *Porites*. See Table III. Their growth-forms are all different, and the localities are different. What their genetic inter-relationships are have to be discovered. As already stated, we do not yet know whether the calicle structure is a function of the growth-form, or *vice versâ*. I am convinced of the fact that, in spite of the variations of the growth-form, even among specimens obviously of the same kind and gathered side by side, the growth-form as a taxonomic character cannot be neglected. The analysis of many specimens shows clearly that there is a tendency to produce and repeat peculiarities of form, not only all over the same stock, however large, but in all obviously related specimens.

a. Zool. Dept. 92. 12. 1. 353.

140. Porites North Australia (8)3. (*P. Australiæ Borealis tertia.*)

(Pl. XXII. fig. 4; Pl. XXXV. fig. 14.)

[Franklin Shoal,* Arafura Sea, 9 fathoms; British Museum.]

Description.—The corallum throws up here and there from a large encrusting base, with thin edges (under 1 mm.) and rough warty surface, shapeless, angular and rudely branching processes, some reaching 4–5 cm. high.

The calicles are minute (under 1 mm.), very ill-defined, and visible mainly as faint rings of pali round a small fossa, quite superficial, and unevenly distributed. The walls are thick, usually flat, covered by a mosaic of frosted granules, not echinulate nor bushy; over small areas the walls are rounded and raise the surface into warty prominences. The septa are not visible. There is an irregular ring of wall granules. The pali, separated by a circular trough from the wall granules, form neat circular rings flush with the surface; they are large, triangular rather than V-shaped, and have the same character as those of the wall and surface; there are from six to eight, the five principals being large. The minute central fossa is usually closed by a tubercle at a slightly lower level than the wall.

* 9° 52¾′ S., 129° 19′ E.

The section shows a loose reticulum in which neither trabeculæ nor horizontal elements are conspicuous; where most regular, both are equally developed with large rounded meshes. The colour is a bright yellowish-brown.

This coral has all the characters of a cœnenchymatous *Porites*. (See Introduction, p. 15.) The single specimen is large, 11 cm. across, and is curiously associated with a *Millepora* of very much the same habit, only the surface and the processes are smoother.

a. Zool. Dept. 92. 4. 5. 27.

141. Porites North Australia (8)4. (*P. Australiæ Borealis quarta.*)
(Pl. XXII. fig. 5; Pl. XXIV. fig. 3.)

[Blackwood Shoal,* Arafura Sea, 10 fathoms; British Museum.]

Description.—The corallum forms irregular open tufts of short, thick (1·5 cm.), gnarled and rapidly tapering branches; they tend to curve outwards and to fork irregularly, sometimes three points radiating from a centre. The living layer extends about 6 cm. down, and has a distinct creeping edge.

The calicles are conspicuous, 1 mm. in diameter. The walls swell up into ramparts about 1 mm. high, sometimes thin, sharp, low ridges, at others taller and round-topped, either surrounding single calicles, which are thus sunk in deep pits, or enclosing two to three calicles in a wavy bent trough; young calicles appear on the swollen tips of the ramparts; the texture of the ramparts is closely reticular, and in contrast with the coarse flaky texture of the intra-calicular skeleton. The septa are broad flat flakes with finely pointed edges, and showing no very marked radial symmetry, but are often curled and bent up, showing lower layers of flakes, which seem to compose the bulk of the intra-calicular skeleton; granules, as the tips of trabeculæ, are rare. Only here and there are the pali developed as a small ring of large granules rising apparently upon the innermost lobes of the flat septa. The section of a branch shows the horizontal elements alone conspicuous; trabeculæ, even in the sections of the ramparts, are only just traceable.

The colour of the unbleached stock is a pinkish or reddish-brown terra-cotta.

There are two specimens which show striking variations: *a* is a complete branching stock (Pl. XXIV. fig. 3) with the characters described; it is 10 cm. high, 4 cm. of which is dead previous growth. *b* has a different growth-form, but it is only a fragment, the branches flattening and forking nearly all in one plane; the calicles are more densely crowded and the ramparts thinner and ragged; the surface has a rougher look than in *a*; and, lastly, the colour is dark brown. This ought probably to have been described under a separate heading.

In addition to these two stocks, united because the type of calicle is the same, and because both have the rampart formation, and both come from the same locality, are two

* 9° 53′ S., 129° 25′ E.

small fragments from Franklin shoal. These are much thinner, and of a peach-yellow colour. These are the more remarkable, because if they belong here, and are regarded provisionally as a variety of *a*, they would form, with *a*, a couple of forms closely paralleled by a couple from the China Sea. So closely, indeed, do these two fragments resemble *P. China Sea 10*, that it is difficult to suppress the doubt whether some accident has not led to a confusion of the specimens. See the two forms *P. China Sea 9* and *10*, and the remarks upon them.

a. Zool. Dept. 92. 4. 5. 40.
b. Zool. Dept. 92. 4. 5. 39.
c, *d*. Zool. Dept. 92. 4. 5. 51.

142. **Porites North Australia** $_{(8)}$**5.** (*P. Australiæ Borealis quinta.*)
(Pl. XXII. fig. 6; Pl. XXIV. fig. 7.)

[Blackwood Shoal,* Arafura Sea, 10 fathoms; British Museum.]

Description.—The corallum forms smooth stems, 3–3·5 cm. thick at the base, and branching rather seldom and at small angles; the branches taper gradually, and end in rounded points 0·5 cm. thick. The living layer is at least 15 cm. deep, with encrusting edges.

The calicles are large, 1·5–2 mm. in diameter, deep, and angular. The walls are simple, steep, and thin; they are irregularly fenestrated, and have strong but ragged and uneven edges. The angles where they meet often rise into wave-like points, which, however, are not pronounced; buds sometimes appear in these angles. The septa project quite irregularly some way below the tops of the walls, mostly as triangular flakes; these obscure the radial symmetry, the appearance of which depends so much upon the regularity of the interseptal loculi; the tips of the septa are thin, as small knobs or rods. The pali rise from these tips; they are very variable in number; the principals are always present, but not especially enlarged, and there are always one or two supplementaries. The central fossa is always deep, sometimes, indeed, without visible floor, at others a small tubercle can be seen rising from a compact reticular columellar tangle.

The section of a stem shows the concentric elements of the skeleton especially strongly developed (compare the flaky septa). The trabeculæ, though stout, are so irregular as hardly to show as radial elements at all.

The colour of the unbleached coral is a dark yellowish-brown.

The specimen is unlike any other in the whole collection. Its growth-form is peculiar, the fine pointed branches are all curved one way, so that the specimen looks like a great bird's claw. Its attachment seems to have been a weak one; the creeping layer of the colony seems almost as if closing over rotten coral, which represents the original stem.

a. Zool. Dept. 92. 4. 5. 24.

* 9° 53′ S., 123° 25′ E.

143. **Porites North Australia** $_{(8)}$**6**. (*P. Australiæ Borealis sexta.*)
(Pl. XXII. fig. 7; Pl. XXIV. fig. 2.)

[Blackwood Shoal,* 10 fathoms; British Museum.]

Description.—The corallum rises from a closely encrusting base into irregular strings of round or oval masses, which are bent about in all directions, sending out off-shoots, which fuse together without order or symmetry. The oval masses are quite small at the tips, 5–6 mm. in diameter, those at the base being about 1·8 cm. The living layer is 7–8 cm. deep.

The calicles are superficial or only faintly pitted; with small central bosses in the bases of large polygonal areas, 1·75 mm. in diameter. The walls look broad to the naked eye, but consist of a low, thin, very frosted or delicately echinulate median ridge, within which are irregular rings of septal granules, usually separate from the walls, of different sizes and lengths, and frequently as echinulate, or even finely branching granules. Within these again are the pali, usually in a close ring, showing the formulæ B or F (fig. 3, p. 19), the principals being large and triangular, and also very echinulate, almost bushy. Beneath these granules the septa can be seen as broad, solid and wedge-shaped, with echinulate edges, and leaving only narrow slit-like interseptal loculi. A pin-hole fossa is visible to the naked eye, but is not very sharply defined because radiating off into the interseptal loculi, and with a minute central tubercle below the level of the pali.

Neither element of the skeleton is well-defined in the section; the trabeculæ are the better developed. The colour of the unbleached coral is a kind of ash-grey with a faint tinge of green, and with a whitish bloom over the surface.

This *Porites* is remarkable for its growth. Those most resembling it are given in Table III. The stock has been broken somewhat, the moniliform excrescences becoming easily detached.

a.
b, *c*, fragments of *a*. } Zool. Dept. 92. 4. 5. 23.

144. **Porites North Australia** $_{(8)}$**7**. (*P. Australiæ Borealis septima.*)
(Pl. XXII. fig. 8; Pl. XXIV. fig. 6.)

[Evans Bank,† Arafura Sea, 15 fathoms; British Museum.]

Description.—The corallum branches, irregularly dichotomously. The branches are about 1·5 cm. thick, bent, and sub-cylindrical, but flattened where the forking or branching takes place; the tips are swollen and slightly flattened, and fork in an irregular manner, one portion of the swollen knob growing faster and thicker (8–9 mm.) than the other, which eventually comes to project like a spur from the side of the thicker and more rapidly growing branchlet. The living layer is 7 cm. deep, the lower edge creeping over the dead previous growth.

* 9° 53′ S., 129° 25′ E. † 9° 5½′ S., 129° 32¾′ E.

The calicles faintly pit the surface, sub-circular, about 1 mm. in diameter. The walls are wide and built of horizontal very feathery flakes, which may be either smooth at the surface or covered with fine flattened feathery granules, the beginnings of the next layer of flakes. These feathery, finely echinulate or frosted granules give a velvety aspect to the surface. The septa are wedge-shaped extensions of the wall-flakes into the calicle, extensions which are regularly constricted so as to form a regular ring of septal granules, separated from the wall by a narrow circular trough. The pali are regular, and mostly appear in formula C (fig. 3, p. 19), that of the dorsal directive being small. A small columellar tubercle rises high in the centre of the fossa. The interseptal loculi are narrow and seem sometimes to run over the wall between the wall granules.

In the section the tangential and radial (trabecular) elements are about equally developed, with only small intervening pores, so that the section seems compact.

The branching of this coral is interesting. Cf. this description and figures with those of *P. North Australia 1*, of which it may be a variety.

a. Zool. Dept. 92. 4. 5. 25.

145. **Porites North Australia** $_{(8)}$**8**. (*P. Australiæ Borealis octava.*)
(Pl. XXII. fig. 9; Pl. XXIV. fig. 4.)

[Parry Shoal,* Arafura Sea, 12 fathoms; British Museum.]

Description.—The corallum rises into a thick, central stem, irregularly swollen, 12 cm. long and 3 cm. thick, and tapering rather rapidly. From the sides of this, thin, slightly tapering branches, 1–1·5 cm. thick at the base, and forking at intervals of 2·5 cm., project at a wide angle, and usually slightly upwards. The edge of the living layer creeps over dead portions.

The calicles are large, 1–1·5 mm., very shallow, almost obsolete, open, polygonal. The walls consist of crisp horizontal flakes, with a median ridge of irregular, vertical and ragged rods, the tips of which expand into smaller flakes, which form the next layer of the wall. This ridge rises slightly above the surface. The septa are short, wedge-shaped prolongations of these flakes, with crisp or frosted edges, with irregular granules scattered over them. The pali rise from constricted end-pieces of these tongue-like septa, and are tall but very irregular, so that no formula applies; they surround a large, rather shallow fossa with a floor of flakes, and a small central tubercle. The interseptal loculi are large, but not very symmetrical.

In section the horizontal layer is compact, and alone conspicuous. The colour of the unbleached coral is a black-brown.

This is one of the branching forms in which the horizontal elements are developed at the expense of the radial.

a. Zool. Dept. 92. 4. 5. 26.

* 11° 9′ S., 129° 39½′ E.

In addition to the foregoing, there are in the Hamburg Museum branching *Porites* of dark brown or blackish colour, which came from the "North Coast of Australia." Dr. Rehberg,* who worked on the Hamburg collection, thought they were of the same "species" as the Fiji form which Dana called *P. nigrescens*. The temptation to class all these blackish branching *Porites* together is very great. The geographical method, however, saves us. Further, even if we were merely grouping into morphological species, no two have the same growth-form, and when we look very closely we see that the calicles are not all built on the same plan. There are also, as here already recorded, two different kinds of skeleton, one with the trabecular, and one with the horizontal, elements most developed.

NORTH-WEST AUSTRALIA.

146. **Porites North West Australia** $_{(8)}$**1**. (*P. Australiæ Occidentalis prima.*)
(Pl. XXIII. fig. 1.)

[Bassett-Smith Shoal, Holothuria Bank, 9 fathoms; British Museum.]

Description.—The corallum appears to build up thick coral crusts by repeated thin layers. But the single specimen shows that, as the coral thickened, it was being destroyed below the living colony by boring organisms, so that its section is here thin, like that of an explanate stock, and there comparatively thick. Creeping edges are very thin.

The calicles are over 1 mm. in diameter, from 0·5 to 1 mm. apart, superficial, ill-defined, and very inconspicuous. The walls are built of layers of flat flakes, which are covered with shapeless granules, twisted threads, and even scales, the granules representing the trabeculæ and the others representing the beginnings of the next layer of flakes spreading out from the rising trabeculæ. The septa are tongues of these flakes, separated by thin interseptal loculi, which straggle to various distances over the wall. The septa themselves become symmetrical, their top edges mostly roughened by the frosted wall granules or threads running out along them; the ordinary septal formula can be made out, but the pali and the palic formula are often obscured. When seen their tips are large, and frosted, flush with the septa, and in formula F, sometimes also B (fig. 3, Introduction, p. 19). There seems to be no appreciable depth to the fossa in which a central tubercle rises, and the interseptal loculi are equally shallow, hence the calicles are inconspicuous.

The section shows an equal development of trabecular and horizontal elements, the former appearing the more conspicuous, being straight and parallel, while those of the latter are wavy and irregular. The colour of the unbleached coral is the same bright yellowish or orange-brown characteristic of so many of the representatives of this North-West Australian group.

* Abh. Naturw. Verein. Hamburg, xii. (1892) p. 47.

This is not the only case known in which the apparent explanate growth is not the natural growth. An exactly similar phenomenon in the case of a *Goniopora* from the same district will be found described in a supplement given in Part II. of this Volume. See also the remarks there made as to the bearing of this upon the species question.

The very broad flakes composing the walls of this coral are not common, at least among the Indo-Pacific *Porites*.

a. Zool. Dept. 92. 1. 16. 37.

147. **Porites North-West Australia (8)2.** (*P. Australiæ Occidentalis secunda.*)
(Pl XXIII. fig. 2; Pl. XXV. fig. 2.)

[Holothuria Bank; British Museum.]

Description.—The corallum rises into irregular clumps of short round lobes or knobs, standing out in all directions. The thin edges are pendent or turned outwards.

The calicles are small, 1 mm. in diameter, sub-circular, slightly depressed, but not conspicuous. The walls are either simple and zigzag, with top edge seldom seen complete, but rising into rods ending in frosted swellings, or (on steep sides) an open flaky reticulum with round pores and the ends running out into minute fan-shaped knobs with echinulate distal edges. The septa are rods swollen and nodulated, and sending up echinulate granules. The five stout principal pali, often with a minute (dorsal) directive palus, rise a short way above the loose septa. The fossa is here and there quite open, but usually closed by a few distinct stout strands of a loose columellar tangle, from which arises a small central tubercle with frosted tip. The interseptal loculi are very large, and open very widely into the fossa.

The section shows very stout, rather wavy trabeculæ not very closely arranged, with, at least in the horizontal explanate portions, very feeble development of the horizontal elements. These would probably be more developed on the steep sides.

The unbleached coral is a pale yellowish-brown or buff colour.

Except that there is not the same pronounced explanate base, this coral reminds one in growth-form and in the character of the calicles of *P. Ellice Islands 3* and *P. Fiji Islands 24*. But none of them are really alike. It would appear as if a general openness or looseness of calicle skeleton accompanies this kind of growth-form.

a. Zool. Dept. 92. 1. 16. 47.

148. **Porites North-West Australia (8)3.** (*P. Australiæ Occidentalis tertia.*)
(Pl. XXIII. figs. 3, 4.)

[Baudin Island reef; British Museum.]

Description.—The corallum is a smooth, rounded or oval nodule, with flattened top. The creeping edges bend a short way under.

The calicles are minute, 0·75 mm. in diameter, without definite outline to the naked eye, superficial. The wall is a reticulum of a simple kind, viz. a median ring thickened by a single synapticular ring on each side, yet together forming a single wall * as a reticulum of thick strands, which end at the surface as stout granules with finely echinulate surfaces. The meshes of the wall reticulum are large, and somewhat regularly arranged. The septa are thick, and their sides are very finely and closely echinulate; the divisions of their upper edges into septal granules and pali is not very marked, and the pali are not conspicuous as a raised ring. They are seen rather as enlargements of the septal tips, and appear to be in the complete formula H (fig. 3). The fossa is deep, but nearly filled up by a large very finely echinulate central column rising free nearly to the surface, and with no apparent junctions with the septa or pali. The interseptal loculi are large, deep and open, in spite of the thickness of the septa.

The section appears to be densely trabecular, the trabeculæ being nodulated. The colour of the unbleached coral is again a light yellowish-brown.

There is only one specimen. The calicles appear to be unique in the exquisitely delicate echinulations hardly visible on the top of the stock (Pl. XXIII. fig. 3), pronounced at the sides (Pl. XXIII. fig. 4).

a. Zool. Dept. 92. 1. 16. 13.

149. **Porites North-West Australia** $_{(8)}$**4**. (*P. Australiæ Occidentalis quarta.*)
(Pl. XXIII. fig. 5; Pl. XXXV. fig. 1.)

[Baudin Island; British Museum.]

Description.—The corallum rises on a rather narrow neck into a rounded oval mass, somewhat flat-topped, and irregularly divided into transverse swellings. The living layer has a depth of 4–5 cm.; it bends only slightly under the overhanging bulging of the sides of the stock, and seldom with growing edges. The coral mostly dies progressively upwards and is covered over with an epithecal film.

The calicles are minute, yet conspicuous, variable in size, about 0·75 mm. in diameter, angular, and distinctly depressed. The walls are simple membranes, hardly fenestrated, hence with continuous edges, which are either straight and thread-like or zigzag, sometimes both, on the different sides of one and the same calicle; short ragged processes project irregularly from the top edge of the wall as the beginnings of the septa. Lower down the crooked roughened septa swell close to the wall, and the swellings at times unite so as to show traces of an inner synapticular wall. Within this the septa are very irregular and thin, and their radial symmetry is frequently obscured. They rise slightly at the centre into low, often flattened, pali, so

* That is, not a thin median ridge with a distinct synapticular ring running round as if part of the intra-calicular skeleton, cf. the "trimurate" condition described in Introduction, p. 16.

irregularly arranged as not to form any ring apparent to the naked eye, or to conform to any formula. A conspicuous straggling columellar tangle irregularly fills up the fossa.

In section the coral is regularly and compactly trabecular. The colour is pale yellowish-brown.

The irregularity of the internal skeleton is interesting, as is also the fact that the colour, not often seen in other *Porites* of the Indo-Pacific area, is closely like that of Nos. 1 to 5 of this North-West Australian group.

a. Zool. Dept. 92. 1. 16. 1.

150. **Porites North-West Australia** $_{(8)}$**5**. (*P. Australiæ Occidentalis quinta.*)
(Pl. XXIII. fig. 6; Pl. XXXV. fig. 3.)

[Baudin Island, reef; British Museum.]

Description.—The corallum appears to rise into an irregular flabellate process, much divided, and with distal branchlets on the larger divisions. The process is from 1–2 cm. thick, 5–6 cm. broad, and 5–6 cm. high. The living layer may be 7–8 cm. deep.

The calicles are superficial or slightly pitted, often sharply defined and circular, 1·25 mm. in diameter. The walls are flat or slightly raised, of various widths up to 1 mm., reticular, dense, simple, that is, composed of a median ridge and two lateral rings of synapticulæ, the trabeculæ rising to large, richly frosted granules, which rather obscure the wall. When the calicles are pitted, the median row of granules is the highest, and from it the rest slope evenly away. The septa are thick, regular and prominent, their edges being divided into richly frosted granules. The septal granules are frequently separated from the wall granules (the tips of the trabeculæ of the inner rings of the walls) by a deep circular trough. More than one such circular trough may be traced round calicles where the granules are large and square. The pali form a ring of granules of the same character as the rest, seldom raised above the level of the septa; their formula is usually complete. The interseptal loculi are deep and long, and run conspicuously into the fossa, which is frequently deep and conspicuous. The central tubercle is small, usually flat and thin.

The section is very strongly trabecular, with rounded irregular pores, and short inconspicuous horizontal junctions. The colour of the unbleached coral is a rather deep brownish-fawn.

It is not easy to say what the exact growth-form of this coral was. There are two fragments, which fit together and make what might be a nearly complete stock, except for the loss of branchlets, or it might be merely a stag's-horn like outgrowth of some larger colony.

The circular troughs round the calicles are commonest in purely branching forms with trabecular structure.

The colour is again closely akin to that of so many of these North-West Australian *Porites*.

a. Zool. Dept. 92. 1. 16. 29.

151. **Porites North-West Australia** $_{(8)}$**6**. (*P. Australiæ Occidentalis sexta.*)
(Pl. XXIII. fig. 7; Pl. XXXV. fig. 4.)

[King's Sound, coll. W. Saville-Kent; British Museum.]

Description.—The corallum forms mounds built up of explanate layers, the upper surfaces of which rise into short, conical, blunt points, with rounded tips; these may flatten and appear as if about to fork. Thin fresh layers creep closely over these processes, showing sharp, clear edges, with slightly projecting epitheca, but seldom free. The living layer may descend 6 cm. deep down the sides of the stock. In young stocks the rising processes may be from 1–2·5 cm. high and under 1 cm. thick. But in older stocks frequent incrustations may thicken them to 1·5 cm. and more.

The calicles are minute, dark, ill-defined spots on a smooth surface, 0·75 mm. in diameter, evenly distributed, from 0·5 to 0·75 mm. apart. The walls are flat, broad, and consist of flat flakes, usually with only small perforations; where the perforations are large, the wall is a filamentous reticulum, and where minute flaky granules and ridges are scattered on their surfaces, such granules sometimes run radially across the walls. The septa are very obscured. Their bases can hardly be traced in the rough edges of the wall-flakes, but lower down small rods can be seen running out to the pali, whose five or six swollen knobs are sometimes almost in contact with the walls. The small, round, interseptal loculi descend vertically from the edges of the flat wall, but seldom form a complete ring. The fossa is either closed by a dense central tangle, or is very open, deep, and conspicuous.

The section shows very irregular, wavy trabeculæ, sometimes apparently lamellate.

This *Porites* has calicles which are not common. If the top edges of the walls round the calicles had been more regular, the calicles would have looked as if punctured into a smooth surface. The flat walls are remarkable, and so is the fact that in some of the smaller calicles, only five to six pali can be seen quite close to the walls with only faint signs of septa.

The growth-form has already been recorded several times. There are two specimens, one small, showing three layers, and one much larger, the layers of which cannot now be counted.

a, *b*. Zool. Dept. 94. 6. 16. 16 and 14.

152. **Porites North-West Australia** $_{(8)}$**7**. (*P. Australiæ Occidentalis septima.*)
(Pl. XXIII. fig. 8.)

[King's Sound, coll. W. Saville-Kent; British Museum.]

Description.—The corallum forms nearly spherical nodules, which may be free and hollowed out.

The calicles are small, 1 mm. in diameter, faintly pitted and crowded. The walls are irregularly reticular, delicately filamentous, with wide meshes along the tops; when the top edges are rubbed off, stouter threads, and even flakes appear. The septa are rather obscured,

an irregular number of small rods, with frosted tips, rising up to the level of the walls. When these are rubbed off, the septa appear to be short, thick, and wedge-shaped. The pali are in the complete formula. The fossa is large, but ill-defined, and has a minute central tubercle.

The calicles of this coral, of which there is only one fine specimen (hollowed out), are very difficult to describe. The delicate filamentous reticulum on the walls, and the tall, thin pali, seem to indicate rapid surface growth; only when this is rubbed off do the stouter elements appear. These latter are alone seen on the under sides of the stock.

a. Zool. Dept. 94. 6. 16. 15.

153. **Porites North-West Australia** $_{(8)}$**8**. (*P. Australiæ Occidentalis octava.*)
(Pl. XXIII. fig. 9; Pl. XXXV. fig. 5.)

[Lacepede Islands, coll. W. Saville-Kent; British Museum.]

Description.—The corallum is explanate and encrusting, with thin, sharp edges. The smooth, wavy upper surface rises into small mammillate processes. Older stocks may form mounds with tall clusters of similar processes and drooping explanate edges. These processes are about 8 mm. in diameter and 1 cm. high.

The calicles are small, 0·75 mm., and crowded. The walls are rather thick, and below the surface appear to be reticular and flaky; their tops are covered with irregularly scattered frosted granules. The septa are short and thick, rather deep down, and apparently without the septal granules between the pali and the granules of the wall. The pali form a conspicuous ring of the usual five principals as frosted granules, sometimes seen united by a ring of tissue; seen sideways they are tall, stout, irregular rods, rising to the height of the walls. The fossa is very minute, and mostly very deep, without central tubercle.

The vertical section shows a fairly regular rectangular network, the meshes being, however, irregular in shape; the trabeculæ and the horizontal elements are about equally developed; here and there, the former may become the more pronounced.

The unbleached coral is a pale fawn colour.

There are three complete stocks, showing three stages of development.

A young explanate colony (*c*), from 1·5 to 2 cm. across, and showing a rising in the middle obviously due to a worm-tube. It is only 1 mm. thick, and the walls and the pali are much lower; the surface appears to be a much more solid and compact arrangement of large granules.

The second specimen (*b*) is about 6 cm. in diameter, with a few scattered mammillate processes, and its expanding edges flat or turned up by coming into contact with foreign objects.

The largest is a mound of fused mammillate processes, about 8 cm. across and 5–6 cm. high, with edges hanging down here, and turned out horizontally there.

The general characters of the coral are very like those of *P. Great Barrier Reef 6* from Palm Island, the skeletal elements of which are, however, lighter and more delicate.

(with *c* upon it). Zool. Dept. 93. 11. 8. 17.

b. Zool. Dept. 93. 11. 8. 12 (part).

Group III.—THE MALAYAN REGION.

154. Porites Timor-laut (1)1. (*P. Timor-lautaensis prima.*) (Pl. XXV. figs. 1, 2; Pl. XXXV. fig. 6.)

[Timor-laut,* coll. H. O. Forbes; British Museum.]

Description.—The corallum grows out laterally as a massive knob, to which continually larger masses are added, also by growing further outwards, the later ones partly encircling those which support it. The under surface of the mass, built up by these successive growths, is nearly horizontal, but the upper surface of each separate growth tends to rise into rounded swellings each higher than the last. The corallum appears to owe its shape to the great numbers of calcareous worm-tubes, which open upon its surface. The living layer is closely encrusting, and creeps far under the projecting mass.

The calicles vary in size from a little over to a little under 1 mm.; very shallow, only faintly pitted, and crowded, sub-circular. The walls are either thin delicate zigzags of bent spiky filaments, or else reticular, delicate, open-meshed, and irregular. Parts of the walls of the same calicles may be reticular, the rest simple or zigzag.

On the lower or under parts of the stock all the skeletal elements are thicker and more echinulate.

The septa are long and echinulate, and, in the upper parts where the elements are very thin, there are often traces of three rings of synapticulæ formed of large echinulæ, one just next the simple zigzag wall, one corresponding with the septal granules, and the third corresponding with the pali; this innermost ring is usually complete. These rings, complete and incomplete, make the columellar tangle very large and irregular. There are no granules on the upper surface, neither wall nor septal, nor are there pali. The skeletal elements are all filamentous and smooth, except in patches where they become flaky, and where the filaments (which are often the edges of vertical lamellæ) are spiky with echinulations. On the under surface the walls become thick and very flaky, and the calicle contains compact rings of septal granules and rod-like pali (mostly the five principals). A columellar tubercle fills up the small fossa.

In vertical section the trabeculæ are close, almost as if lamellate, and separated by oval pores. The mass is dense.

The growth-form is somewhat remarkable. The specimen is 15 cm. long, and appears to have grown as a heavy, flattened, club-shaped mass, 13 cm. wide and 7 cm. thick at the tip, from

* Dr. Forbes kindly informs me that his corals were all found near the entrance to the channel named by him "Wallace's Channel," and therefore in the Arafura Sea side of the islands called Timor-laut.

the side of some rock. There are so many calcareous worm-tubes opening on its surface, that it is possible that the coral may, in some way, owe its shape to them. They may become attached to the lower surface of the projecting coral, and then, curving upwards towards the light, become slowly grown round.

a. Zool. Dept. 84. 3. 7. 1.

155. **Porites Banda Sea** $_{(2)}$**1.** (*Porites Banda prima.*) (Pl. XXV. fig. 3; Pl. XXXV. fig. 7.)

[Banda, coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites arenosa* (*partim*) Quelch (*non* Esper), Chall. Rep. xvi. (1886) p. 183.

Description.—The corallum appears to envelop some prominence or ridge of the substratum (dead corals, worm-tubes, shells, etc.), and to swell into an irregular knob with rounded humpy surface. The lower edges closely adhere and descend 5 cm.

The calicles are minute, sub-circular, 0·8 mm. in diameter, shallow, but definitely and sharply pitted. The walls are occasionally single and raggedly zigzag, often membranous but mostly they are irregularly reticular, apparently filamentous, but really membranous or flaky; at times the flakes, tilting sideways, are conspicuous along the tops of the walls. The septa are long, and, seen from above, filamentous, slight, bent, angular, but with few echinulations. They soon join a large, very open columellar tangle of fine threads; its topmost elements are the partial rings which join the pali; below this level fresh rings can be seen in the interseptal loculi, making larger circles. Pali, granules on the walls and septa, and a central tubercle begin to appear in the calicles on the sides, and, though very irregular, are most developed near the lower edges of the colony. The circle of pali is large. The pali themselves begin as ragged flakes, or as plates, but turn into rods. The formula seems to be complete, but it is irregular.

The section shows a rather dense trabecular structure somewhat obscured by the lamellate character of the otherwise rather delicate trabeculæ. The remains of a yellowish fawn colour can be seen.

This coral is interesting because, though very unlike the specimen last described, analysis shows it to be a closely allied form.

a. Zool. Dept. 86. 12. 9. 363.

156. **Porites Banda Sea** $_{(2)}$**2.** (*Porites Banda secunda.*) (Pl. XXV. fig. 4.)

[Amboyna, coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites palmata* (*partim*) Quelch (*non* Dana), Chall. Rep. xvi. (1886) p. 180.

Description.—The corallum is branching, forms short stems slightly compressed, about 1 cm. thick and 1·5 cm. broad. The stems fork at an angle of 60°, the branchlets being about

2 cm. long before they again prepare to fork. The living layer reaches down about 6 cm. The lower edge is usually closely encrusting, showing also signs of creeping.

The calicles are small, about 1 mm. in diameter, but, except round the bases of the stems, conspicuous. The walls are broad, flat flakes, upon which tall, thin, very ragged median ridges arise, which form the apparent walls separating the calicles. These are the trabeculæ, the tops of which are about to expand into the next layer of flakes. The septa are stiff, irregular tongues of these flakes, without any radial symmetry, with a few gashes or pores, representing a few of the interseptal loculi. There are different layers of these septal tongues, and when pali form, granules rise from their tips. Some may arise from the top, and others from a lower layer. The ring, when developed, is large and the pali few, but, owing to the obscurity of the radiation, the formula can hardly be made out. The fossa is sometimes open, very deep, and fairly sharply circumscribed, at others it is quite irregular. Here and there, the wall ridges are themselves broad, ragged flakes, and, in the absence of the radial symmetry and of the fossa, the whole surface is a confusion, in which calicles can hardly be recognised.

The cross section shows very thick concentric elements, with very slight trabeculæ. The texture is not dense.

This is one of the branching *Porites* with its horizontal or concentric skeletal elements chiefly developed. Table III. shows how many there are now known, while a reference to the descriptions and figures will show how different are their growth-forms. It may be the same coral as that referred to by Professor Studer * from Amboyna as "*P. saccharata.*" But the growth-form is different, and further the *P. saccharata* of Brüggemann comes from Singapore. There is no similarity between the growth-form of this coral and that of Dana's "*Porites palmata,*" which, I gather from Dana's figures (see p. 162), has the same principle of structure.

a. 2 single detached stems and 1 fragment. Zool. Dept. 86. 12. 9. 313.

Another specimen was obtained by H.M.S. 'Challenger' from Banda, and was called by Mr. Quelch *P. Gaimardi* M.-E. & H. (see Chall. Rep. xvi., p. 183). It is very insufficiently described, simply as a thick, erect, rather elongated mass, slightly flattened above. The cups are said to be 1·5 mm. wide, and the columella very distinct, though small. For an account of *P. Gaimardi* M.-E. & H., see p. 90.

* Mittheil. Naturw. Gesell. Bern., 1880, p .25.

MOLUCCAS.

157. Porites Moluccas (1)1. (*P. Moluccensis prima.*)

Syn. *Madrepora punctata* Esper, Suppl. (1797) p. 86, pl. lxx., figs. 1, 2.

Description.—The corallum is encrusting, 6–8 mm. thick in the middle, about 1 mm. at the edge. There is a well-developed epitheca.

The calicles are slightly pitted. The walls are thick and built of a flaky reticulum, the flakes being freely perforated with rounded pores; the septa from ten to twelve (sometimes twenty, probably in double calicles). The interseptal loculi are long, narrow, oval, and symmetrical. The fossa is either a single deep pit or else filled up with a columellar tangle from which points may rise.

The texture is strikingly flaky. There are no surface granules, and the appearance might suggest that the real surface had been rubbed off.

This is Esper's description of a coral found encrusting a shell ("*Anomia Sella*"), from the Moluccas. It was said to differ from all other corals in its "blätterichte gewebe." This, however, is a known character in Poritidæ. Whether the form is a *Porites* or *Goniopora*, is uncertain, but the fact that the septa are mostly ten to twelve, seems to decide the matter in favour of *Porites*. The twenty septa occasionally found might be attributable to double calicles. On the other hand, Esper's fig. 2 shows calicles with more than twelve septa, and yet of the same size as those with only twelve.

The synonymy, as is the case with most of these old "species," is somewhat confused.

Linnæus described a coral from the "European ocean" as *Madrepora punctata*, in terms which admit of being interpreted as referring to a *Porites*, in which the pali are suppressed and the calicles visible simply as rings of ten to twelve interseptal loculi. But it is pure guesswork to say that Linnæus' and Esper's specimens were specifically identical.

The confusion does not end here, for in 1834 Ehrenberg described a small specimen which he found in the Berlin Museum as "*Porites punctata* Linn. and Esper"; the latter of these it could not possibly have been, because Dr. Klunzinger tells us that the columella is not very developed, and further because he found it to be specifically identical with a group of young colonies encrusting a *Pinna* from the Red Sea, and called by Ehrenberg *M. Porites arenacea*; and these again, according to Dr. Klunzinger, are specifically identical with specimens which he himself collected in the Red Sea, one of which he photographed (Pl. V. fig. 27). This photograph shows a form very different indeed from that figured by Esper.

In 1851, in their 'Polyp. foss. ter. Pal.' p. 143, Milne-Edwards and Haime expressed their conviction that Ehrenberg's *Porites punctata* was not the *Madrepora punctata* of Linnæus, and made a new genus for it, *Stylarœa*, placed it as one of their Poritinæ and called it *Stylarœa mülleri*. In the same year, however, as if giving up the struggle, they replaced it among the *Porites* as "*Porites punctata* Linn.-Esper.-Ehrenberg" (Monographie des Poritides, p. 30).

For further details see *Porites Red Sea 9*.

The specimen from Ceylon (see *P. Ceylon 16*), which had been called *P. punctata* by Ridley, is more like Esper's figure than any other form in the National Collection, but there is little chance of their being closely related owing to the great distances apart of their localities.

PHILIPPINES.

158. **Porites Philippines** (6)**1.** (*P. Philippina prima.*) (Pl. XXV. fig. 5.)

["Sooloo Sea," coll. Wilkes Expedition, 1838–42; coll. H.M.S. 'Challenger'*; British Museum.]

Syn. *Porites palmata, et nigrescens* var. *mucronata* Dana, Zooph. (1848) p. 558, pl. liv. figs. 2, 3, 3*a*.
Porites palmata Quelch, Chall. Rep. xvi. (1886) p. 180.

Description.—The corallum grows into large tufts rising upon a thick central stalk by repeated dichotomous forking, the latter occurring about every 2 cm. The stems and branchlets are compressed and frequently fuse into flabellate plates running out into short conical or blunt digitiform processes. The living layer only extends some 6–7 cm. down the branches of the tuft; the lower dead portions have been repeatedly thickened by the downward creeping of the edges, the thickness near the base of a living branch being from 1·5–2 cm. The widths of the flabellate plates depend upon the number of stems which have fused together.

The calicles are superficial, but distinct, on an average slightly over 1 mm.† in diameter. The walls are built of rather thin, smooth, horizontal flakes with median ridges composed of the separate tips of the trabeculæ in various stages of expansion into a fresh layer of flakes. These median ridges are conspicuous over all the upper parts of the stems, but gradually disappear near their bases, where the walls consist of horizontal flakes with scattered granules. The septa are tongues of these flakes, often thin, and sufficiently divided as to show some traces of radial symmetry. The usual formula can frequently be made out, and the five principal pali form an open ring of small granules round the fossa. This, except when very deep and open, is shallow, being soon filled by a flaky columellar tangle upon which an irregular granule represents a central tubercle.

The section shows a very loose reticulum of large oval meshes arranged horizontally. The trabeculæ are feebly developed and seldom in pronounced radial arrangement. The horizontal elements are far better developed, but they are thin and wavy, and seldom form well-defined continuous layers.

This is the description of the large Zamboangan specimen collected by H.M.S. 'Challenger,' and identified by Mr. Quelch with Dana's *P. palmata*. Dana's description might in every

* Zamboanga.

† Mr. Quelch describes the calicles as from 1–2·5 mm. across. This is hardly a correct description of the fact that there are a few double calicles visible.

respect apply to this coral, while Dana's figure might represent a flabellate stem detached from such a stock.

The same may be said also of Dana's "*P. nigrescens* var. *mucronata*," the specific identification of which with *P. palmata* was suggested by Milne-Edwards and Haime. Dana found the two growing together, the specimen of *P. palmata* being partly covered by the other. This description seems to imply that the growth was distorted by crowding. If so, it would be quite sufficient to account for any differences in growth-form and finer structure which might appear. The facts that both of them form flabellate branching stems, that in both the walls are built of flakes, and that they come from the same locality, are quite sufficient to justify their being put under one heading.

a. Zool. Dept. 86. 12. 9. 298.

The fragments from Amboyna, which Mr. Quelch joined with these as *P. palmata*, are built on the same essential plan, but the stems are thinner. There are no visible traces of flabellate formations; the calicles are smaller, and the median ridges on the walls are taller, continuous and membranous. The skeletal elements are stouter, and the texture rougher.

Compare Table III. for other branching *Porites* built up mainly of the horizontal skeletal elements.

159. Porites Philippines (6)2. (*P. Philippina secunda.*)

[Sooloo Sea, coll. Wilkes Expedition, 1838–42; ?]

Syn. *Porites erosa* Dana, Zooph. (1848) p. 565, pl. lv. figs. 8, 8*a*.
Porites ? erosa M.-E. & H., Ann. Sci. Nat. xvi. (1851) p. 34.
Synaræa erosa Verrill, Bull. Mus. Comp. Zool. i. (1864) p. 43.

Description.—The corallum is stout, erect, massive, columniform, truncate at summit, erose and deeply incised, lateral surface sparingly monticulose, and rarely subcarinate. It is alive for 6 cm.

The calicles are superficial, distinct except at the apex, as a compact mosaic of large, square or triangular granules arranged in two rings, an outer septal ring, and an inner ring of pali. The wall granules are indistinct and sharply separated from those of the calicle by a narrow circular trough. The interseptal loculi are also narrow and sharp. Six of these run between the often triangular pali into the minute fossa.

This coral, of which there is unfortunately no specimen in the National Collection, is clearly one of the cœnenchymatous *Porites*, and the character of its calicles, together with its method of growth as shown in Dana's figure, should make it easy to identify.

160. Porites Philippines (6)3. (*P. Philippina tertia.*)

[Mactan Islands, coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites lutea* Quelch (*non* M.-E. & H.), Chall. Rep. xvi. (1886) p. 184.

Description.—The corallum forms rounded or oval masses, adhering by a broad base to the substratum; the lower edges may bend under or outward and creep over the substratum.

The calicles are about 1 mm. in diameter, distinctly but slightly pitted, mostly quite circular. The walls are reticular and of varying thicknesses up to 0·5 mm. The reticulum is apparently coarse and irregular, and built of large, frosted granules. Round meshes can often be made out, and these are sometimes arranged in rows as if the reticulum were regular. Here and there on one side only of a median wall ridge an inner synapticular wall may appear. In the uppermost calicles the septa, projecting only far down, are short, very thick and frosted, with clear separation of wall and septal granules. It is only in the shallower lateral calicles where the large pali and the other granules form concentric series of rings. These pali, usually the five principals, rise high as thick, stout, frosted rods. The fossa is shallow and soon filled up. The central tubercle is very small. The interseptal loculi are very narrow and inconspicuous between the thick, frosted septa.

The large frosted granules of the walls give a soft woolly appearance to the coral. The section appears to be trabecular and dense. There are traces of a light yellowish fawn colour.

There was no special reason why this coral should have been called *P. lutea* (see p. 34). There is only one specimen, which seems to have been affected by a boring sponge, and, when collected, half of the upper surface had been killed. The reticulum, consisting of coarse granules, is its most interesting feature.

a. Zool. Dept. 86. 12. 9. 319.

161. Porites Philippines (6)4. (*P. Philippina quarta.*)

[Mactan Islands, coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites mirabilis* Quelch, Chall. Rep. xvi. (1886) p. 185, pl. xi. figs. 5, 5*a*.

Description.—The corallum is massive, coarse, and gibbous, encrusting at the base.

The calicles are sub-polygonal, from 1–1·15 mm. in diameter, nearly superficial, but slightly excavate. The walls are rather narrow, acute, often thickened, and very porous; the septa are very thin; there are five to six long pali, and a styliform columella.

The texture is close and firm, very finely reticulated.

This specimen, the original of which has been mislaid, and was not available for examination by the author, was distinguished by an immense number of double calicles, and these presented so remarkable an appearance that Mr. Quelch thought them a reliable specific character. They can be found on most specimens, and their presence in great numbers in this particular specimen was probably accidental.

The above description is from Mr. Quelch's text.

162. Porites Philippines $_{(6)}$5. (*P. Philippina quinta.*) (Pl. XXV. fig. 6; Pl. XXXV. fig. 8.)

[Philippines; British Museum.]

Description.—The corallum rises into large, solid, round-topped masses like inverted cones. The tops are wavy or slightly indented. The living layer extends only 3–4 cm. down the steep sides.

The calicles are minute, about 0·75 mm., only slightly pitted. The walls, thin and zigzag, are rows of minute frosted granules, the tips of trabeculæ. In the angles and on the sloping sides they are often reticular, the network being granular, open, and delicate. The septa are very thin and delicate, and here and there rise to the surface, but most frequently the parts most visible are the septal granules, which rise either as granules or as short radiating plates and mostly distinct from the wall. Within this ring are the small frosted pali in a large open ring. The complete formula is frequently seen. The central tubercle is frequently flattened and thin. The interseptal loculi are large and open, and the whole intra-calicular skeleton appears scanty, at least at the surface, where it chiefly consists of well-spaced frosted granules. These surface granules at the sides of the stock may all be flattened and appear like the tips of lamellate plates, radial arrangements of them forming the walls.

The vertical section shows a very dense arrangement of fine trabeculæ distinctly showing lamellate surfaces. The meshes are frequently like oval pores in a membrane. The colour of the unbleached coral is brown.

There is one large incomplete stock; it is a wedge-shaped mass split down longitudinally. Boring molluscs in the heart of the original stock from which it was broken seem to have prevented its growth from being regular and symmetrical. A great cavity with sloping sides opened on its top.

There is no other *Porites* like it in the collection.

a. Zool. Dept. 98. 4. 21. 1.

163. Porites Philippines $_{(6)}$6. (*P. Philippina sexta.*) (Pl. XXV. figs. 7, 8.)

[Zamboanga, coll. H.M.S. 'Challenger'; British Museum.]

Syn. *Porites explanata* Quelch, Chall. Rep. xvi. (1886) p. 181, pl. xi. figs. 3, 3*a*.

Description.—The corallum is small, thin, explanate, attached by the centre to the back of a Gastropod shell (*Murex*) on which it was carried about. Its edge is free for 1 cm. all round the margin, supported by epitheca, and sharp, but thickens rapidly to 1–1·5 mm.

The calicles, though 1 mm. in diameter, are difficult to distinguish, being ill-defined as

irregular depressions or scratches in the flat surface of the reticulum, but they appear to be all slightly and irregular tilted, making the surface rough. The wall skeleton is melted down into a flaky reticulum, the surfaces and edges of the flakes being quite smooth and showing no surface granules. The flakes, tilted sideways and running into threads, build up an irregular layer without any apparent trabecular elements, at least at the surface. The calicles are distinguishable mainly by the round fossa circumscribed by a usually smooth complete ring from which a few irregular plates or flat rods stretch to the wall, seldom showing much regard for radial symmetry. The pali are represented only by a few slight thickenings on the rings surrounding the fossa. The interseptal loculi are very irregular and usually large, but only occasionally are they conspicuous, one here and there being deep like the fossa.

This *Porites* is very remarkable in its texture; no others, not even the remarkable forms from the China Sea (No. 4) show such an extraordinary specialisation of the horizontal elements of the skeleton (fig. 7). Attached to the specimen are layers of fine membranes built up by an encrusting Bryozoan; the resemblance between its flaky texture and that of the coral is noteworthy.

Sheltered under the edges of the main stock is what appears to be a very young colony of a *Porites* which may be the same, but it is very different. It is also explanate and built up of a flaky reticulum, but the edges of the flakes are everywhere finely jagged. The walls are thinner, the septa are longer, and seem to meet irregularly in a central plate, which obliterates all traces of a fossa (fig. 8).

What the inter-relationships of these two *Porites* are, whether this small one is a younger colony of the same or some quite different coral, cannot be decided. Nor do we know whether this attachment to a Gastropod shell is normal or merely accidental, nor, if the latter, how far the specimen owes its special features to this fact.

a. Zool. Dept. 86. 12. 9. 314.
b, a small stock under *a*.

I conclude that the coral was carried about on the living *Murex* from the fact that it is tilted a little above the tip of the siphonal tube, as if to avoid the movements of the siphon.

CHINA SEA (LOO-CHOO, MACCLESFIELD BANK, TIZARD BANK).

164. Porites China Sea (19)1. (*P. Sinensis prima.*)

[? Loo-Choo (Liu-Kiu) Islands, coll. Wm. Stimpson; ?]

Syn. *Porites tenuis* Verrill, Proc. Essex Inst. v. (1866) p. 25.
non *Porites tenuis* Quelch, Chall. Rep. xvi. (1886) p. 184.

Description.—The corallum is glomerate, globose, attached by a narrow stalk; surface irregular, uneven.

The calicles are "very small" (1·25 mm.), and shallow, crowded, polygonal; walls thin and very porous; septa twelve, imperfect, open, trabecular; pali five or six, well developed; columella very small and tubercular.

This is the original description of a *Porites*, probably from the Loo-Choo Islands in the China Sea. It is too meagre for purposes of identification.

The specimen from Honolulu called *P. tenuis* by Mr. Quelch, has been described above as *P. Sandwich Islands 8*.

There has been a tendency to give the name "*tenuis*" to all *Porites* with thin membranous walls.

165. Porites China Sea (19)2. (*P. Sinensis secunda.*)

[Hong-Kong, coll. Wm. Stimpson; ?]

Syn. *Porites* sp. Verrill, Proc. Essex Inst. v. (1886) p. 25.

Description.—The corallum is glomerate; said to be too young for identification.

The calicles are polygonal, rather deep; the walls well developed, angular, acute; septa well developed; six strong pali; deep open fossa; no columella.

This coral was said to "approach *Rhodaræa*." This expression, without figures to explain it, has now lost its meaning.

166. Porites China Sea (19)3. (*P. Sinensis tertia.*) (Pl. XXV. fig. 9.)

[Macclesfield Bank, 30–34 fathoms, coll. Bassett-Smith; British Museum.]

Description.—The corallum is explanate, thin, horizontal, and, except for its attachment by one of its edges, free upon a stout supporting epitheca. The corallum is slightly wavy, but its surface is raised into warts and papillæ. The edges are very sharp and thin, 0·5 mm.; near the attachment the stock may be 6 mm. thick.

The calicles are about 1 mm. across, tend to be arranged somewhat close together in rows, the rows being about 1 mm. apart, the intervening space bulging upwards. Their rounded walls rise here and there into papillæ which may run together into ridges, or more frequently fuse to form warty excrescences of different heights up to 3–4 mm. The texture of the wall is flaky, but the top is covered with the frosted ends of flakes and the tips of trabeculæ, appearing as branching granules in the process of expanding into new flakes. The septa begin as short tongues with jagged edges sloping down towards the fossa. They only lengthen and meet deeper down and at different levels. The pali are conspicuous, and rise as a ring of rods from lower septa; they consist of the five principals, with here and there a smaller dorsal directive palus. The interseptal loculi are well developed, and gashed back among the wall flakes; they are very irregular, a few of them deep, but lower layers of flaky septa with obscured radial

symmetry tend to close them up. The fossa is small and deep, with only faint traces of a tubercle far below the surface.

The aspect of the coral is soft and woolly. The vertical section shows trabecular and horizontal elements about equally developed, large rounded pores, and a slight tendency for the whole to melt down into a flaky reticulum.

The colour is a rich reddish-brown.

This beautiful cœnenchymatous *Porites*, with its tendency to melt down into a flaky reticulum, is interesting in association with the next form, in which the reticulum has been dissolved into a system of horizontal flakes. There are several quite different forms of cœnenchymatous *Porites* in this China Sea group.

Some of the warts seem to be due to the presence of Balanids, but cœnenchymatous papillæ may be seen rising without any visible cause.

a. Zool. Dept. 93. 9. 1. 77.

167. Porites China Sea (19)4. (*P. Sinensis quarta.*) (Pl. XXVI. figs. 1, 2, 3; Pl. XXXV. fig. 9.)

[Macclesfield Bank, 23–40 fathoms, coll. Bassett-Smith; British Museum.]

Description.—The corallum is explanate, thin, with smooth, level or slightly wavy surface. Old stocks may consist of a series of flat discs increasing in size one above the other, and with free edges which are thin, 1 mm., and sharp; their central regions are about 5 mm. thick.

The calicles are large, 1·5 mm., ill-defined, visible to the naked eye on unbleached specimens owing to the presence of dried dead matter; on bleached specimens only discoverable with a pocket lens. The walls are flat, variable, sometimes 1·5 mm. in width. They are built of flat flakes with raised, slightly curling edges, but typically without surface granules, which would indicate the presence of trabeculæ; with few, and those very small, perforations through the flakes. These wall flakes invade the calicle and entirely obscure the radial symmetry. No definite formulæ can be seen in septa or pali. A few curling points to irregular septal tongues represent the pali.

The vertical section (Pl. XXVI. fig. 2) typically shows a loose open reticulum built up of wavy horizontal elements, with no clear traces of continuous trabeculæ.

The colour of the unbleached coral is a rich light brown.

This coral is one of the most remarkable in the whole group, because it shows an extreme specialisation of the horizontal elements with obscuration of the vertical trabecular elements. It is especially remarkable because a *Goniopora* occurs in the same locality and at about the same depth, which shows a similar structural differentiation, and is of the same colour. Thus *forms of two distinct genera have acquired almost identical characters in the same locality—though they retain their generic distinction.* This is the more interesting because in each case their characters are among the most striking yet known in their respective groups; indeed, only the wide oversight of the range of possible forms which the Museum collection affords

enables us to recognise their systematic positions at all. This, I think, supplies us with a very strong argument in favour of the power of the environment in moulding the forms of animal life.

There are five specimens in the National Collection which may be here grouped together; they all show striking variations.

a. Is a large flat shield-shaped disc, supported on a series of earlier smaller discs. The successive discs seem to start irregularly, a portion of the colony somewhere near the centre arching upwards suddenly in order apparently to surmount some foreign organism; the edges of this rising portion grow outwards above the colony from which it sprang.

a. 37 fathoms (Pl. XXXV. fig. 9). Zool. Dept. 92. 10. 17. 87.

b. Is a much smaller colony, showing traces only of some four to five earlier growths. The characteristic features are again shown very clearly.

b. 30–40 fathoms (a note on the label describes the polyps as showing "a complete circle of twelve white tentacles.") Zool. Dept. 93. 9. 1. 74.

c, d. Two very minute and probably young colonies of the same. Both show the same essential structure as *a* and *b*, but yet differ from both. They are thin, one of them extremely so, 0·5 mm. In this thinner one, although it is nearly 3 cm. long by 1·5 broad, there are only two layers of skeletal flakes above the epitheca, and the calicles are difficult to make out even with a pocket lens (Pl. XXVI. fig. 3). In the thicker one there are six layers of flakes, and the calicles are easier to find.

c, d. 23–40 fathoms. Zool. Dept. 1904. 10. 17. 41 and 42.

e. Is a larger colony, 8 cm. long, and showing traces of some six previous growths, the youngest as small as *c*. This coral is remarkable as a kind of transition form. It has a similar habit, but its surface is granular, and its section, though showing an immense development of wavy horizontal elements, yet has distinct vertical trabeculæ which appear at the surface in the granules upon the wall flakes, in the distinct ring of pali, and in the columellar tubercle. The question may well arise as to the correctness of placing it here. We have no evidence which would justify us in dogmatising at all about its affinities. That it is a transition form leading from the usual arrangement with developed trabeculæ to this with purely horizontal elements is obvious, but in the face of the fact above described of representatives of two distinct genera becoming so alike under the influence of the environment, we cannot tell but that this may be some entirely different *Porites* also being slowly modified in the same direction.

e. 31 fathoms. Zool. Dept. 92. 10. 17. 95.

There is also a bottle containing three small fragments in spirits, 40 fathoms.

168. Porites China Sea (19)5. (*P. Sinensis quinta*.) (Pl. XXVI. fig. 4.)

[Macclesfield Bank, 13 fathoms, coll. Bassett-Smith; British Museum.]

Description.—The corallum is explanate and thin, and in struggles with other organisms seems to build up an irregular crust, with edges here free, there adhering, and with a surface

raised into mounds and excrescences. The thickness reaches at least 3 mm., the edge being very sharp with the epitheca projecting.

The calicles are over 1 mm., depressed, shallow, cup or funnel-shaped. The wall rises to a ridge nowhere sharp and yet not rounded, and consisting of the expanding, finely echinulate tips of the bent and irregular filaments and flakes which build up the wall. These seem to end freely and give the surface a woolly appearance. The septa are very irregular and consist of continuations of the wall flakes from different levels, of various sizes and breadths, and with finely echinulate or toothed edges. Their fusions can be made out by looking down from above. The pali are inconspicuous, and their tips fray out into fine echinulæ, usually five or six in a large ring, but the exact formula is difficult to discover. The fossa seems to be early closed by flakes from which a small inconspicuous columellar tubercle rises. The irregular interseptal loculi of adjacent calicles seem to communicate freely between the filaments and flakes which stand up all over the surface.

The vertical section shows a very loose open reticulum in which both vertical and horizontal elements are about equally developed, neither of them being conspicuous. The meshes are very large. The colour is a rich dark brown.

This coral has a very beautiful surface skeleton consisting of raised loose ends, terminating in fine echinulæ or spikes. This looseness is found expressed in the section by the great size of the meshes. In an earlier draft of this work I was inclined to associate the single specimen with the larger corals from Tizard Bank, *P. China Sea 13*. But the texture is entirely different.

a. Zool. Dept. 92. 10. 17. 116.

169. Porites China Sea (19)6. (*P. Sinensis sexta.*) (Pl. XXVI. fig. 5.)

[Macclesfield Bank, 17 fathoms, coll. Bassett-Smith; British Museum.]

Description.—The corallum is explanate and closely encrusting, without any trace of free edges, but following the irregularities of the substratum.

The calicles are minute, generally under 1 mm., crowded, and distinctly pitted. The walls are stout and reticular on the higher parts of the stock, but thin and simple on the lower; in the former case, the reticulum is close and of coarse, stout threads, ending in knobs which make the whole surface granular. When thin, the walls are nearly straight, continuous rows of finely echinulate, almost bushy granules. The septa are not sharply defined, appearing as frosted irregular points on the inner faces of the walls at different levels; their meetings are rather deep down. The pali rise as frosted knobs, but they are invisible to the naked eye and quite inconspicuous; the four lateral principals are regularly developed, and the other four quite irregularly. The fossa is small and obscure, and with traces of a columellar tubercle.

This specimen is a small complete stock, closely encrusting a mass of dead coral

made rotten by boring organisms, so that it is difficult to ascertain whether it has been built up by former growths of this *Porites* or by Astræids. There is no section visible. The chief structural peculiarity of this *Porites* is its surface texture, which has no crispness or precision about it, but it appears to be a confused arrangement of rough or frosted granules.

a. Zool. Dept. 93. 9. 1. 94.

170. Porites China Sea (19)7. (*P. Sinensis septima.*) (Pl. XXVI. fig. 6.)

[Macclesfield Bank, 17 fathoms, coll. Bassett-Smith; British Museum.]

Description.—The encrusting corallum should apparently be massive, but, as the polyp tissues leaves the skeleton, coral-boring organisms destroy it, so that the living layer appears to creep over the decayed remains of previous growths. The edges are thin and sometimes free.

The calicles are conspicuous, slightly over 1 mm. in diameter, and surrounded with ramparts. The walls are flaky, and on the top of the flakes there arises a coarse reticular rampart of filaments and flakes, the ends and tips of which are flattened and echinulate. These ramparts vary in height; they are blunt, but with sharp ridges, and, where they are conspicuous, cause the calicle to appear in the base of a pit. The septa are long, coarse, irregular tongues of the stout wall flakes, with echinulate edges, some broad, others narrow and bent, and seldom showing more than traces of the radial symmetry. Above these septa occasional flakes project from the ramparts as the beginnings of the next layer. The pali rise from the tips of the septa and their echinulate tips are the only granules seen in the calicle. They are small and very irregular upon a large loose ring; traces of the complete formation are seen here and there. The fossa is very shallow, and a small tubercle may be discovered rising irregularly from the flaky strands which fill it up.

The vertical section shows a very coarse reticulum with large meshes and stout elements. The trabeculæ are fairly straight and thus conspicuous, but the horizontal elements are frequently much stouter. The colour of the unbleached coral is a greyish-brown, looking dusty owing to the presence of the fine echinulæ at the edges and tips of the flakes.

This is one of the cœnenchymatous *Porites*, the walls rising up between the calicles to form ramparts into which the polyp can retreat. In this genus the polyps are not, as a rule, able to retreat fully into their skeletal receptacles. An extra rampart would, however, serve the same purpose as a deep calicle.

The surface of the coral is covered over with Balanids and worm-tubes, and perhaps owes part of its irregularity to the fact that the living layer has had to spread over a previous growth similarly infested with foreign organisms.

This coral is apparently closely related to No. 13 of the China Sea group.

a. Zool. Dept. 93. 9. 1. 95.

171. Porites China Sea (19)8. (*P. Sinensis octava.*) (Pl. XXVI. fig. 7.)

[Macclesfield Bank, 17 fathoms, coll. Bassett-Smith; British Museum.]

Description.—The corallum forms a thick encrusting mass with smooth surface, raised into slight conical waves, separated by narrow but evenly concave valleys; without free edges.

The calicles are small, 0·75 mm. in diameter, flush with the surface. The walls appear broad and flat, and covered with very minute and delicate granules. These rise from the surfaces or edges of flat flakes with very crisp echinulate edges. These flakes make the wall look solid. The septa are thin but very echinulate tongues of these flakes, some from the uppermost layer, others from the next lower. Septal granules and pali rise to the level of the wall. They are very delicate, minute and echinulate, the four lateral principal pali being slightly larger than the rest. The palic formula is complete, the ring being large and loose. The fossa is shallow, and an echinulate, frequently flattened tubercle rises nearly to the surface.

The vertical section shows a dense mass, in which the trabeculæ and the horizontal elements are about equally developed, so far as quantity is concerned, but the trabeculæ, inasmuch as they are continuous, are the more conspicuous. A horizontal section looks solid but with a scurfy surface.

The colour of the unbleached coral is a dusty greyish-brown.

This *Porites*, with its surface covering of exquisitely minute echinulate granules, the echinulæ sometimes meeting as if to form a delicate surface reticulum which would later become flaky, recalls the delicate surface reticulum seen on a rare foliate form, which will be described in Part II. among the specimens from unknown localities. This feature and its flaky texture should make the form easy to identify.

a. Zool. Dept. 93. 9. 1. 93.

172. Porites China Sea (19)9. (*P. Sinensis nona.*) (Pl. XXVI. fig. 8.)

[Macclesfield Bank, 13–23 fathoms, coll. Bassett-Smith; British Museum.]

Description.—The corallum forms a close ragged tangle of short thick stems all fusing together without apparent order. The stems are of no definite shapes, swollen, nodulated, and forking. The lower levels die down, and the living colonies at the top may creep over them as small encrusting stocks with edges only slightly free. No tuft with freely rising stems and branchlets is known; they probably appear as the early stages of growth.

The calicles are obscure, but indicated by the positions of the ramparts. A young calicle opens on almost every cœnenchymatous uprising. The walls appear to be a reticulum of fine echinulate threads, and they rise up here and there above the level of the calicles into papillæ of very delicate reticulum; these papillæ may be single and scattered, or fused together into

clumps. Small calicles opening on the papillæ appear to be shallow cœnencyhmatous cups raised above the general surface. The septa and all the internal skeleton are obscured at the surface by the great numbers of tall echinulate rods with frosted tips, which seem to fill up the apertures of the calicles. Their radial arrangement, however, can be made out, for the interseptal loculi are usually distinct, and the septa can be seen as broad stout flakes. The pali can generally be made out as an irregular ring of small bunches of echinulæ. The formula seems to be uncertain, the taller principals being most developed, the rest remaining variable. The fossa is irregular, and with a large tubercle forming its floor rather deep down.

The section shows a very irregular arrangement of stout but discontinuous horizontal elements closely packed together. The trabeculæ are not conspicuous as radial rods; they vary much in thickness, being mostly thin.

The colour of the unbleached coral is a greenish-grey, suffused here and there with a rose-pink.

This coral is closely paralleled by *P. North-West Australia 4*; the ramparts in that coral show the same delicate filigree texture as here, but the flakiness of the septa is not obscured by the tall echinulate rods, and the specimen is an erect tuft. In this form we have only fragments of small colonies creeping on the surface of a tangle of old broken-down stems which may at one time have begun as small branching tufts.

Very remarkable is it (so remarkable indeed, that it is difficult to keep from believing that some accident has led to the mixing up of the specimens), that we have a variety of this form from the China Sea (see under the next heading), which is structurally similar to two small fragments above recorded as a variety of *P. North-West Australia 4*. These fragments, being very small, were not separately described. They not only show the same structure as *P. China Sea 10*, but also the same tendency to form horizontal explanate discs, growing out freely, with the coral forming the top surface and a Bryozoan the under surface.

a. Seven fragments of a tangle of dead branches with small colonies and parts of colonies creeping over them — Zool. Dept. 92. 10. 17. 92.

173. **Porites China Sea** (19)**10**. (*P. Sinensis decima.*) (Pl. XXVI. fig. 9; Pl. XXXV. fig. 10.)

[Macclesfield Bank, 17 fathoms, coll. Bassett-Smith; British Museum.]

Description.—The corallum rises into small loose tufts of thin, bent and angular branches which freely fuse together; as the tufts die they form a tangle upon which the new growths rest. Stems or branches frequently send out horizontal or drooping explanate plates. The branchlets vary from 6–10 mm. in thickness, and the living layers vary from 6–7 cm. deep.

The calicles are 1 mm. in diameter, conspicuous chiefly because sunk down between ramparts. The walls are built of stout, mostly horizontal flakes, drooping a little on each side into the calicles. From the surface of the walls reticular round-topped ramparts arise, which

gyrate among the calicles, seldom forming distinct circles round individual calicles. The texture of the reticulum is flaky at the base, the flakiness disappearing as it rises, till its top ridge is nearly filamentous. Flakes frequently droop down the sides of the ramparts towards the calicles, and their tips are very finely echinulate. The septa are broad tongues, sometimes constricted, very irregular and finely echinulate laterally, the radial symmetry being only preserved by those interseptal loculi which open into the fossa; these are deep and give a stellate appearance to the calicle. The pali rise as frosted knobs, but their ring is usually very irregular, and the formula is difficult to make out because of the irregularity of the septal flakes. The fossa is deep, with a small tubercle some way below the surface. The section shows very stout horizontal elements, and slight trabeculæ which appear at the surface as the pali and as the granules or vertical elements which rise above the surface of the flakes forming the cœnenchymatous reticulum.

The colour of the unbleached coral is a rich yellowish fawn, with a suspicion of pink in it, almost peach-coloured.

There are several fragments of this coral; all the larger pieces show signs of having risen from incrustations on dead previous growths, and some of them put out round horizontal expansions sometimes associated with a Bryozoan. The coral forms the top, the Bryozoan the under surface of such expansions.

The specialisation of the cœnenchyma into ramparts is interesting, especially occurring so near to another form which shows the same specialisation (see form last described), yet differs in so many other details.

A similar specialisation is seen in *P. North-West Australia 4*, of which there is one complete stock resembling *P. China Sea 9*, except that it has retained its probably original erect tuft formation, and, what is most strange, two fragments *c* and *d* almost exactly like this coral, with similar expansions of the colony into round plates associated with a Bryozoan. The resemblance is so close as to suggest some accidental mixture of the specimens. If the specimens are correctly labelled according to their localities, then we have a remarkable coral in North-West Australia with a variety, and a similar coral from the Macclesfield Bank with an exactly similar variety.

a. Five fragments of a branching tangle. Zool. Dept. 93. 9. 1. 198.

174. Porites China Sea (19)11. (*P. Sinensis undecima.*) (Pl. XXVII. fig. 1.)

[Tizard Reef, lagoon, 6 fathoms,* coll. Bassett-Smith; British Museum.]

Syn. "*Porites arenosa*" Bassett-Smith (*non* Esper), Ann. and Mag. Nat. Hist. 6°, vi. (1890) p. 456.

Description.—The corallum builds up masses of dense rock by the creeping over the surface of small colonies with very thin edges.

The calicles are only slightly pitted, 1 mm. across. The walls are low, but have a faint median ridge consisting only of a row of minute, frosted, almost bushy granules. These mark

* This is on the label, but in Mr. Bassett-Smith's published notes of his identifications, the depth is given from 2 to 6 fathoms.

off the calicles into polygonal areas. On each side of this ridge the walls and septa slope down to form shallow funnel-shaped depressions. These are surrounded by large, thick, wedge-shaped, frosted masses, which represent both the wall and septal granules in one. The pali form a small, distinct, compact ring visible to the naked eye, as rising slightly in the base of the depression. The complete formula is frequently visible. The fossa is small, with traces deep down of a columellar tubercle.

The section shows a close array of very stout, straight trabeculæ with much slighter horizontal junctions. The colour is a very pale fawn.

There are about six patches of this coral on the surface of a great piece of coral rock, which appears to have been built up by this *Porites*. The largest is some 6 cm. long, and the smallest is but 1 cm. in diameter. It is impossible to say whether the coral always grows in such patches, or whether they represent parts of the same coral, the intervening portions having died away.

This coral, though in general habit not unlike No. 5 from the Macclesfield Bank, is yet different in all details except growth-form and in the fact of the surface consisting of very frosted granules.

a. Zool. Dept. 89. 9. 24. 75.

At one side of the largest patch is a minute colony of *Montipora* under 2 mm. in diameter and containing about three calicles (one large and two small) in a small epithecal saucer.

175. Porites China Sea $_{(19)}$12. (*P. Sinensis duodecima.*) (Pl. XXVII. fig. 2.)

[Tizard Bank, Nam-yil reef, 3 feet, coll. Bassett-Smith; British Museum.]

Description.—The corallum is massive or in thick, flat cakes. The living layer bends over and hangs steeply down the vertical sides of fractures.

The calicles are minute scattered stars, here crowded, there dispersed, about 0·5 mm. in diameter. The walls are smooth and flat between individual calicles, but rise up into smooth, rounded papillæ which run together to form miniature mountain-ranges as much as 2 mm. high and broad with systems of hollows, gullies and intervening valleys. Calicles are scattered over these ranges—never, however, on the topmost or sloping ridges, always in depressions. The texture of the wall is very loose and open, being a maze of sharp, clearly-defined, very jagged threads or flakes with the interseptal loculi of adjoining calicles running into one another. The papillæ consist of a rather dense filamentous reticulum, but round their bases they are flaky and run into the flakes of the surface. Where the coral hangs over, the wall consists of broad, smooth, flat flakes, with very scanty perforations, and their surfaces are covered with small frosted granules, the tips of trabeculæ. Here also the papillæ are built of flakes, but the

surface granules branch and meet to form a surface filamentous reticulum. The septa take their characters from those of the walls into which they run; their lateral edges are always finely echinulate. The pali are most conspicuously developed down the pendent sides, where they appear like the other trabecular granules and in a ring of six (Diagram C, fig. 3, p. 19). On the top surface, where the radial symmetry is obscured in the open loose reticulum, the pali are only just traceable. The fossa is deep, irregular on the top surface, but neat and round down the sides. Traces of a columellar tubercle can be seen.

The vertical section shows long thin trabeculæ, not as straight rods but rather as wavy threads, often slightly lamellate, streaming towards the surface; the horizontal elements are quite irregular.

The colour is a cold light fawn.

This *Porites* is quite unique in the collection. It recalls the two Red Sea forms called by Dr. Klunzinger *Synaræa undulata et lutea*. On the genus *Synaræa* see Introduction, p. 9.

The specimen seems to be a piece out of a flat cake 2 cm. thick. Underneath, it has an epitheca, as if it had been detached from the surface to which it adhered, and two of its sides seem to have been broken away on some previous occasion and to have been covered over by the bending down of the living surface almost at right angles.

a. Zool. Dept. 89. 9. 24. 81.

176. **Porites China Sea** (19)**13**. (*P. Sinensis tertiadecima.*)
(Pl. XXVII. fig. 3; Pl. XXXV. fig. 11.)

[Tizard Bank, 6–7 fathoms, coll. Bassett-Smith; British Museum.]

Syn. *Porites crassa* Bassett-Smith (*non* Quelch), Ann. and Mag. Nat. Hist. 6°, vi. (1890) p. 456.

Description.—The corallum is explanate, with warty surface expanding freely into large slightly concave dishes attached by their centres, or else building up with other organisms thick crusts, the coral creeping in patches over the irregular surface. The edges are rounded and thick, though sometimes with a stout chalky epitheca projecting. The stock may reach the thickness of 8–10 mm.

The calicles are conspicuous and open, sharply sunk, 1·2 mm. in diameter. The walls are coarsely reticular, and tend to surge up between the calicles in rather full-rounded ridges. These upsurgings occur in groups, which cause small patches of the surface to rise up into rough rounded warts which start suddenly from the surface. In texture, the rounded wall-ridges are coarse and very thick (? flaky) but covered with a layer of finer filamentous reticulum. The walls are thinner in the smooth level valleys between the warts.

The septa are thick, coarse, and with very uneven sides, leaving only short, narrow, irregular but deep slits as interseptal loculi. They only project deep down and send up tall rod-like pali which end in frosted granules, usually as four large lateral principals and two smaller directives. A columellar tangle with a central tubercle can be seen a little way down the fossa.

The section shows a loose open reticulum, of which thick irregular trabeculæ are joined by even thicker and more irregular horizontal elements. The pores are large and open in the valleys, but tend to be small and the skeleton consequently dense under the warts.

The colour of the unbleached stock is a dark dull brown.

There are two large specimens, one a complete dish-shaped free explanate growth (*a*), and a crust built up of scattered colonies creeping upon dead previous growths, algæ, etc. Both have warty surfaces, but this is much more marked on the larger specimen.

Mr. Bassett-Smith's identification of it with the 'Challenger' coral named by Quelch *P. crassa* from Fiji is evidently based upon the fact that in both, the calicles tend to be sunk between uprisings of the walls (see p. 48).

Compare this coral also with one from the Macclesfield Bank, *P. China Sea 7*.

a. A large circular dish, with bleached fragment. Zool. Dept. 89. 9. 24. 161.
b. A coral crust. Zool. Dept. 89. 9. 24. 172.

177. Porites China Sea (19)14. (*P. Sinensis quartadecima.*)

(Pl. XXVII. fig. 4; Pl. XXXV. fig. 13.)

[Tizard Bank, 2·5 fathoms, coll. Bassett-Smith; British Museum.]

Syn. *Porites crassa?* Bassett-Smith (*non* Quelch) Ann. and Mag. Nat. Hist. 6°, vi. (1890) p. 456.
Porites lichen? Bassett-Smith (Pars.) (*non* Dana) ibid.

Description.—The corallum is encrusting, with or without free edges. Old stocks may build up solid masses by repeated incrustations. The surface is wrinkled.

The calicles are conspicuous, somewhat deep, crowded, 1–1·25 mm.; the walls coarsely reticular everywhere, with sharp irregular edges, which rise in wave-like points at the angles (on the tips of which young calicles may appear); below their sharp edges they often thicken greatly. The septa are short and not apparent round the aperture, but deep down they appear rather thick, crooked, and with jagged edges and tips, but with conspicuous radial symmetry. The pali are mostly eight in number, the larger size of the four principals rendering them visible to the naked eye. They are long jagged rods, which do not rise nearly to the height of the wall. The septa are so deep down that the large palic ring is separated from the high walls by a deep trough, while within is a large fossa, in the base of which, at various depths, sometimes very deep down, a columellar tangle, with or without a large knob-like tubercle, can be seen.

The section shows a very loose open reticulum, with large meshes of irregular shapes and sizes; neither trabeculæ nor horizontal elements are conspicuous, but the rectangular pattern is visible.

There are two specimens: a small encrusting, much wrinkled plate (*a*), found "west of *S. Garvan Reef*," with edges free, and a large conical mass (*b*), ? exact locality, which stood on its apex, and was built up by a colony with calicles exactly like those of *a*, but there is no certain sign that its edges were ever free.

Mr. Bassett-Smith suggested that the massive specimen was specifically identical with *P. China Sea 13*, while the small explanate colony was equally closely allied to Quelch's "*P. lichen*" (= *P. Sandwich Islands 6*). But, daring as it may be to group together the explanate colony *a* with the massive specimen *b*, the evidence of the calicles compels us to do so. There are further sections of *a* which show that it could easily develop into a massive form by continuous growth.

a. Zool. Dept. 89. 9. 24. 82.
b. Zool. Dept. 89. 9. 24. 130.

There is a spirit specimen which seems to belong here; it is a fragment of an explanate growth.

c. Zool. Dept. 89. 9. 24. 10.

178. **Porites China Sea (19)15.** (*P. Sinensis quintadecima.*)
(Pl. XXVII. fig. 5; Pl. XXX. fig. 27.)

[Tizard Bank, Ituaba, 2 fathoms, coll. Bassett-Smith; British Museum.]

Syn. "*Porites solida* var. *a* Forsk" Bassett-Smith, Ann. and Mag. Nat. Hist. 6°, vi. (1890) p. 457.

Description.—The corallum is massive, forms great irregular stony ridges, the living colony being confined to the top, extending irregularly from 3–7 cm. down the sides, with occasional creeping edges. The surface is broken up into broad flat ridges, which tend to have sharp median keels, and are separated by narrow valleys with sloping sides.

The calicles are conspicuous, somewhat deepened, about 1 mm. in diameter. The walls are everywhere thin, sharp, straight ridges, granular or frosted, with roughened sides, on which the septa only slowly appear. These latter are short, thin, and frosted, regularly radial and well spaced, with wide interseptal loculi and large open fossa. The pali are inconspicuous, hardly larger than the septal granules, and nowhere rise into rings visible to the naked eye. A flattened tubercle appears in the fossa.

In spite of the thinness of the skeletal elements, walls and septa, the section is almost massive, as if built of very thick trabeculæ, separated by minute irregular pores. The colour of the unbleached coral is dark brown.

The general character of the calicles reminds one of those of *P. Sandwich Islands 6* and *7*. But nothing is gained by *assuming* that therefore the specimens are genetically related. The same remark applies to Mr. Bassett-Smith's suggested identification of a Red Sea coral. Even if Forskål's description could be shown to be that of a *Porites*, and could be amplified and proved to be of a specimen like this coral, we should know nothing of the real affinities of the forms.

a. Zool. Dept. 89. 9. 24. 87.

179. Porites China Sea (19)16. (*P. Sinensis sextadecima.*)

(Pl. XXVII. fig. 6; Pl. XXXV. fig. 16.)

[Tizard Bank, Sand Kay, 3 feet, coll. Bassett-Smith; British Museum.]

Syn. "*Porites tenuis* Verrill" Bassett-Smith, Ann. and Mag. Nat. Hist. 6°, vi. (1890) p. 456.

Description.—The corallum rises into thick short columns, with nearly vertical sides, irregularly fluted near the top. The uppermost surface rises into low mounds, corresponding with the flutings. The living layer extends irregularly as far as 5 cm. downwards.

The calicles average 1 mm. in diameter. The walls appear thick, but everywhere with a low, sharp median ridge, consisting of thin trabeculæ lightly joined together. This rises upon a coarse, flaky reticulum, which is often regular, that is with a row of pores on each side of the median ridge. The septa project from the sides as frosted points, which increase in length gradually down towards the base of the fossa. Their meetings can, as a rule, only be made out in the shallower lateral calicles. There are no visible pali, and the centre of the large fossa is filled with an irregular reticulum from which granules arise, among which pali and columellar tubercle can at times be vaguely made out.

In section the trabeculæ appear stout. The colour is a bright yellow fawn.

There is no good section exposed; the single specimen is complete. It may be closely related to the next specimen, which is from the same locality. The growth-form and the absence of pali are points of resemblance, but on the other hand the calicles are so unlike that we have to describe the specimens separately.

Zool. Dept. 89. 9. 24. 77.

180. Porites China Sea (19)17. (*P. Sinensis septimadecima.*)

(Pl. XXVII. fig. 7; Pl. XXXV. fig. 18.)

[Tizard Bank, Sand Kay, 3 feet, coll. Bassett-Smith; British Museum.]

Description.—The corallum rises as a smooth, slightly swollen and irregular knob on a short thick stalk. The living layer extends 5–6 cm. downwards.

The calicles are superficial or only faintly pitted, averaging 1 mm. in diameter. The walls are broad and flat, and composed of an ill-defined, close, flaky reticulum, with small pores, and with the edges of the flakes making the surface look scurfy. The septa appear as broad tongues of these flakes with roughened or jagged edges; they may be at different levels and slope gradually with the fossa. Seen from above the septal formula is complete, but there are only traces of pali. The base of the fossa appears to be occupied by a large oval tubercle reaching to the height of the septa.

This coral bears some resemblance in its growth-form to the last, and also in the size of

the calicles and in the absence of pali. There are also slight traces of colour left which seem to show that in that respect also they agreed. But the other details differ very widely. There is no good section exposed which might have helped us. It may be noted that Mr. Bassett-Smith regarded them as distinct, whereas in my first draft of this Catalogue, when I was attempting to group the forms genetically, I had classed them together. I think there can be no doubt of their affinity, but until we can show transitions between the many different kinds of calicles presented by the specimens, we must describe them separately.

For the coral called "*P. lutea* Quoy and Gaimard" by Milne-Edwards and Haime, see p. 34.

a. Zool. Dept. 89. 9. 24. 78.

181. Porites China Sea (19)18. (*P. Sinensis octavadecima.*)
(Pl. XXVII. fig. 8; Pl. XXIX. fig. 3.)

[Tizard Reef, Itu-aba (south side), 2·5 fathoms, coll. Bassett-Smith; British Museum.]

Syn. *Porites conferta* Bassett-Smith (*non* Dana), Ann. and Mag. Nat. Hist. 6°, vi. (1890) p. 456.

Description.—The corallum is ramose, with branches cylindrical, irregular, not very divergent, the tips blunt and rounded, sometimes slightly compressed and forking, the prongs growing unequally. In old stocks the stems and branches are continuations of the dead tangle of early growths. The edges of living layers sometimes grow down these dead branches, sometimes turn up and grow out freely like a collar. The depth of the living layer is variable, from 4 cm.

The calicles are distinct, polygonal, shallow, nearly uniform in size, slightly over 1 mm. The walls are built of elegant, lobately-branching, horizontal flakes. Near the tips of the branches they have a median ridge of frosted or branching granules, below and on each side of which the peripheral portions of the septa are represented by rounded flakes, projecting into the cavity with delicately frosted edges. The well-developed pali (in formula C, fig. 3, see Introduction, p. 19) form a conspicuous ring which encloses a distinct pin-hole fossa, with a minute columellar tubercle.

The section shows an immense thickness and compactness of the horizontal or concentric elements, with hardly any traces of regular trabeculæ.

The colour of the unbleached coral is nearly black.

The calicles of this type remind one strongly of the well-known figure given by Milne-Edwards and Haime (Ann. Sci. Nat. xvi. (1851), pl. i.) of the calicles of Lamarck's *P. furcata*. The method of growth is, however, quite distinct.

The only specimen is a tangle of fused dead stems, tips of which are alive in separate patches, each reaching to a depth of about 4 cm. It is thus a portion of an old growth infested and distorted by Balanids, worm-tubes and galls, while the axes of the stems, even in the living portions, are deeply stained with magenta, indicating the presence of a clionid sponge. Even

the ultimate filaments and granules of the surface are frequently hollowed into fine tubes, apparently by the well-known coral-boring alga.

Esper's coral, called by Dana *Porites conferta*, with which Mr. Bassett-Smith identified it, is a *Goniopora*.

a. Zool. Dept 89. 9. 24. 76.

182. **Porites China Sea (19)19.** (*P. Sinensis nonadecima.*)
(Pl. XXVII. fig. 9.)

[Tizard Bank, Sand Kay, 3 feet, coll. Bassett-Smith; British Museum.]

Syn. "*Porites mucronata* Dana" Bassett-Smith, Ann. and Mag. Nat. Hist. 6°, vi. (1890) p. 456.

Description.—The corallum rises from a narrow stalk into a broad, smooth, flabellate expansion, the upper edge of which divides irregularly into stout branches; these may again expand and again divide. The ultimate branchlets are round, sometimes slightly constricted, and pointed, and from 4–6 cm. long; the tips may divide into small diverging points. The living layer is 12–13 cm. deep, its lower edge showing a tendency to creep downwards.

The calicles, except on the terminals, are very ill-defined, as mere breaks in the smooth surface about 1 mm. in diameter. The walls are everywhere flat, and consist of broad flakes (except on the terminals where the flakes rise into a low, irregular, median ridge). The flakes are much broken up and have elegantly frosted edges, and their surfaces are covered with granules, which are expanding irregularly into a new layer. The septa are tongues of these flakes, of different widths and at different levels; the radial symmetry being frequently quite obscured. The pali are mere granules on the tips of the septal tongues, often almost constricted off from them. There may be as many as eight. Flakes stretch right across the fossa a short way down, and from them a small columellar tubercle rises.

The section shows very stout, irregular, concentric layers, with only very slight and irregular traces of radial trabeculæ.

The colour of the unbleached coral is a rich reddish-brown.

This is another of the numerous branching *Porites* which show a great development of the horizontal elements, and the comparative suppression of the trabeculæ (see Table III.).

The growth-form is striking. On the coral called *Porites mucronata*, by Dana, which was also built on the same principle, see p. 163.

a. Zool. Dept. 89. 9. 24. 74.

SINGAPORE.

183. Porites Singapore (7)1. (*P. Singaporensis prima.*) (Pl. XXVIII. fig. 1; Pl. XXXV. fig. 19.)

[Singapore,* coll. Raffles Museum; British Museum.]

Description.—The corallum is massive, the upper surface rising into rounded humps which overhang the base. As the mass grows in size, these humps seem to grow out to form rounded cushion-like edges, 2·5 cm. thick, free of the early growths, and sheltering them as under an umbrella. The earlier growths may be found overturned. The living layer may extend 3–4 cm. under the projecting edges of the stock.

The calicles average 1 mm. in diameter, conspicuous because sharply sunk. The walls are sharp, simple, straight, slightly denticulate, a nearly regular lattice-work; only on the tips of mounds or where mounds are just beginning to appear calicles occur having reticular walls with young buds appearing in the angles. On the under surfaces, the walls are faint rows of flattened granules forming straight ridges between shallow funnel-shaped calicles.

The septa are thin and finely echinulate; they appear just below the edges of the walls and slope with ragged edges—indicating the presence of septal granules—into the fossa. The pali form an irregular inconspicuous ring of frosted or echinulate points, rising no great height in the fossa. The four lateral principals are moderately developed; the directives are seldom large. The full formula is often traceable.

The interseptal loculi are large and open, and the fine lateral echinulæ of the septa can be seen to unite to form a delicate network, which, as an open columellar tangle, sometimes rises into view. The central tubercle is very thin, delicate, and flattened.

The section seems to be finely and closely trabecular. The colour of the unbleached stock is a warm grey.

There are three specimens, which seem to belong together.

a. The smallest shows a basal fracture about 5 cm. across; above this, the lateral swellings extend some 12 cm., while the top, which is 10 cm. above the base, runs out into short thick humps. The living layer only descends some 6 cm. Some five previous growths seem to be enveloped or capped by the last colony. A boring sponge has made them quite rotten. The calicles appear to be slightly larger than 1 mm.

a. Zool. Dept. 98. 12. 1. 28.

b. Shows a basal section of about 4 cm., above which the knobbed mass expanded more or less evenly and rapidly for 16 cm., the lateral out-growth projecting quite horizontally

* Specimen *c* is said to be from West Singapore, and this is probably the locality of the other two specimens as well.

as a thick cushion-shaped edge, 30 cm. across; above this the stock is a low conical mound rising into humps all over the top, but smoother round the periphery, where the mass is freely expanding. Large portions of the dead previous growths are again rotten.

On the under surface the calicles are shallow and funnel-shaped, and the internal skeleton consists of several concentric rings of very echinulate granules which diminish in size towards the centre. The wall granules are distinct from those forming the median ridge, the septal granules, pali, and central tubercle are usually distinct, separated by concentric troughs and radial interseptal loculi.

b. Zool. Dept. 98. 12. 1. 29.

c. Is like *b*, only not so large; the mass supporting the umbrella-shaped stock, consisting of the previous growth, appears to have rolled over, and upon it the large expanded stock is perched. It is said to be from West Singapore.

c. Zool. Dept. 93. 7. 22. 21.

Compare the method of growth of the next form, and especially the texture of the tips of the humps or processes. On the expansion of thick free edges, compare *P. Ceylon 1–8* (Pl. XXXV. figs. 29, 30, 31).

184. **Porites Singapore** (7)**2**. (*P. Singaporensis secunda.*) (Pl. XXVIII. fig. 2; Pl. XXXV. fig. 24.)

[West Singapore, coll. H. N. Ridley; British Museum.]

Description.—The corallum is massive, and thickening gradually and smoothly above the base for a short distance. The uppermost parts rise into lobes and mounds, which are frequently flat-topped and with nearly vertical sides. The base is 6 cm. by 5 cm.

The calicles are small, 0·75 mm., rather shallow, opening on the flat tops of the humps in an open, undifferentiated, reticular cœnenchyma, here flaky, there filamentous. The walls on these flat tops are mostly thin, membranous, and ragged; on their vertical sides they are less membranous, and more of an irregular ragged lattice-work. The septa in the former case are thin, smooth and wavy, so that the intra-calicular skeleton fills the calicle like a loose open reticulum with very obscure radial symmetry. On the sides of the humps, the radial symmetry appears, but the septa are irregular; they appear round the margin as stalked knobs which represent the septal granules, within which is a ring of tall pali. The formula appears to be complete, but the arrangements of the ventral triplet are irregular. The central tubercle is as large as the lateral pali, to one of which it is frequently joined by a strand. The granules are all frosted.

The section shows the trabeculæ as the chief constructive elements. They appear to be largely lamellate, and to stream towards the surface. The traces of continuous horizontal elements are few. The colour is a light brown.

This coral appears to start very much in the same way as those last described. It bulges out everywhere above the base, but the swellings of its sides have a shape of their own, and are

led in their upward growth by undifferentiated cœnenchyma. In *P. Singapore 1* the rounded knobs are led by calicles usually with reticular walls or at least with reticular angles in which young calicles open. Then, again, the calicles are here much smaller and quite different in skeletal details from those of *P. Singapore 1*.

The upward growth of lamellate trabeculæ reminds us of what has been described as the sheaf method of growth of *Goniopora*. But in this case it is not uniform, showing itself only in patches which give rise to the surface mounds.

a. Zool. Dept. 91. 8. 9. 12

185. Porites Singapore (7)3. (*P. Singaporensis tertia*.) (Pl. XXVIII. fig. 3; Pl. XXXV. fig. 15.)

[Singapore, coll. Raffles Museum; British Museum.]

Description.—The corallum rises into a solid irregular ridge, the upper surface of which divides up into vertical columns, slightly nodulated and flattened, rounded and thick below, but thinning and widening at their tips. The columns rise some 8 cm. high, but when crowded they fuse together, leaving only 3–4 cm. free. The living layer extends downwards from 8–9 cm.

The calicles are 1·5 mm. in diameter, circular, sharply defined on the tips of the columns, but less so on the vertical sides. The walls in the former case are thin, and, like the septa, formed out of streaming lamellate trabeculæ, seen from above as a loose open reticulum of nearly smooth filaments. The walls in this case rise high, and the calicles are deep.* Down the vertical sides, the walls are thick and consist of flakes; on some sides raised into a reticulum, on others flattened down to appear as almost a solid mass. In the former case the calicles are deepened; in the latter they are nearly superficial. The septa are radially symmetrical, very thin, and nearly smooth on the tops of the columns, but on the sides they show signs of granules. Distinct wall granules appear on the flakes round the shallow calicles; septal granules, forming a symmetrical ring round the pali, are everywhere seen except in the tops of the columns. There appear to be seven pali, owing to the fact that the middle granule of the ventral triplet appears to lie outside the ring, though not exactly as far out as the ring of septal granules. There is a central tubercle, and the fine strands of the columellar tangle can sometimes be seen uniting the pali and tubercle. The tangle is conspicuous in the calicles on the tops of the columns, in which there are no pali. Owing to the delicacy of the septa, the interseptal loculi are large and open.

The section shows a central lamellate streaming layer, running up the axis of the columns and showing at the surfaces of the tops; all round this the trabeculæ radiate outwards as filaments rather than as lamellæ. The colour seems to be an ashy brown.

There are two large specimens, *a*, *b*, which fit together, and several small fragments, some of which can be fitted on to fractures of *a* or *b*. The stock, however, was never quite complete, and the exact growth-form is therefore not discoverable.

* When calicles open in a reticulum of vertical lamellæ they are usually flush with the surface.

There is no overlooking the resemblance of the fine texture of this coral to that of *P. Singapore 1*, yet it would be impossible to unite them.

a–f. Parts of a stock. Zool. Dept. 98. 12. 1. 27.

186. **Porites Singapore** (7)**4**. (*P. Singaporensis quarta.*) (Pl. XXVIII. fig. 4; Pl. XXXV. fig. 21.)

[West Singapore, coll. H. N. Ridley; British Museum.]

Description.—The corallum consists of a clump of very thick stems, few in number, bent, twisted, and here and there fusing together into a compact mass. From their knobbed sides and ends, short, irregularly conical, round-topped processes project in all directions. The stems average 4 cm. in thickness; their processes are from 1–1·5 cm. thick near their tips, and 2 cm. long.

The calicles are conspicuous, circular, 1·5 mm. in diameter. The walls are thick, round-topped and reticular on explanate surfaces, with a lattice-work median ridge, which thickens regularly.* Higher up on the stock the walls are flaky, and the edge consists of a rather ragged filamentous reticulum, the early processes of the formation of new flakes. The septa are thick and symmetrical; they show regular constrictions between the wall and the swellings which represent the septal granules, and again, between these and the pali. The latter form a large oval ring, in complete numbers and with a central tubercle, usually flattened in the directive plane. A columellar tangle can be seen just below the surface, frequently with a cruciform arrangement of bars joining the central tubercle to the lateral pali.

The section shows a streaming axial strand apparently consisting of lamellate trabeculæ; this comes to the surface in the round tips of the processes, and is surrounded by a thick layer of regularly radial trabeculæ, arranged compactly with rows of minute meshes separating them. The colour of the unbleached coral is a rich dark brown.

This coral appears as if it started as an explanate stock, the central region of which rose up into a coarse bent conical process, which soon divided. There is such a young stock on specimen *b*; it looks as if it were an independent colony which had started growing on a dead stem.

The growth of the stems tends to break up the living layer into separate colonies. There are as many as four on the complete specimen made by fitting *a* and *b* together. The lower edges of these colonies frequently creep downwards, as if they were closely encrusting the dead lower parts. The specimen may have been free.

The growth-form, the large size and the symmetry of the calicles, with their stout skeletal elements, ought to make it easy to recognise this coral again. On the small explanate colony above mentioned, it is noticeable that there is a tendency in the directive planes to run parallel with one another.

a. Zool. Dept. 91. 8. 9. 14.
b. Fits on to *a*. Zool. Dept. 91. 8. 9. 13.

* By the addition of a synapticular ring. See Introduction, p. 16.

187. **Porites Singapore** $_{(7)}$**5**. (*P. Singaporensis quinta.*) (Pl. XXVIII. figs. 5*a*, 5*b*; Pl. XXIX. fig. 4.)

[West Singapore, coll. Raffles Museum; British Museum.]

Description.—The corallum rises into irregular clusters of erect knobbed processes, 6–7 cm. high, rounded near the base, but greatly widened above, and with straight flat tops which all reach to about the same height. These processes divide up, and put out smaller flattened branchlets with narrow necks, and all bending up into the vertical. The explanate base creeps widely over the surface, the thick edge nowhere really free, but drooping, and even bending under; small upright processes are scattered round the central cluster. The surface is everywhere smooth. The spatulate tops of the processes are from 2–4 cm. greatest breadth, and from 1–1·5 cm. thick.

The calicles are superficial in faintly marked polygonal areas, 1·2–1·5 mm. across. The walls on the vertical sides consist of low, thin, median ridges, composed of single, more or less discontinuous rows of small frosted or branching granules. On each side is a horizontal shelf of flakes, sometimes separated from the median ridge by a row of small pores. On explanate surfaces the median ridge does not rise above the wall-level, and consists of a few threads, or even meshes of a very delicate filamentous reticulum which widens out at times in the angles. On the tops of the processes, the calicles open in a smooth reticulum, composed of filaments and flakes twisted in all directions (Pl. XXVIII. fig. 5*a*).

The septa, in the calicles with wall ridges, appear at the surface as so many separate frosted granules (Pl. XXVIII. fig. 5*b*). The outermost ring—the septal granules proper—stand upon, and at the edge of, the wall shelf. Within this is the ring of pali, individual pali being sometimes joined high up with their corresponding septal granules. The complete palic formula is usually developed. On the explanate surface the septa are long and straight, with very echinulate, almost bushy, edges; they taper away to fine points in the centre, without showing either septal granules or pali. The fossæ are small, with a minute central tubercle.

In the section there is the axial streaming of the flaky reticulum, surrounded by a thick layer of the radial trabeculæ, which are far apart and separated by large circular meshes. The colour seems to have been brown.

This coral, in having a streaming axial layer, coming to the surface at the tips of columns, which it appears to shape, is like *P. Singapore 2*, *3*, and *4*. But its growth-form is quite peculiar. It has some faint resemblance to that of *P. North Australia 1* (the *S. dilatata* of Brüggemann). Its calicles differ from those of all the other Singapore specimens.

a. Zool. Dept. 93. 7. 22. 20.

188. **Porites Singapore** $_{(7)}$**6**. (*P. Singaporensis sexta.*) (Pl. XXVIII. fig. 6; Pl. XXIX. fig. 5.)

[Singapore, coll. ? ; British Museum.]

Description.—The corallum rises and swells above a narrow base into an irregular cluster of coxcomb-like ridges. Along the tops of the larger, older ridges smaller ones arise,

sometimes in double rows. The smaller ridges begin as low, thick mammillæ; these, when they have room to develop, swell above the neck into squarish flat-topped knobs, about 1 cm. high and 1 cm. broad, which may then lengthen to 2 or 3 cm. The depth of the living layer is 7–8 cm. The small original base measures 2 by 3 cm.

The calicles are small, nearly uniformly 1 mm., slightly pitted near the tops of the ridges, but superficial down the sides. The walls are everywhere low, sharp ridges; on the tops (except where the calicles are opening in a streaming flaky reticulum) these ridges tend to be continuous membranes, but down the sides they are straight rows of small frosted granules, either resting upon a narrow irregular shelf of flakes or running along the edge of an obscure reticular thickening. The septa are short, thick, granular, and highly echinulate. There is a complete and conspicuous ring of septal granules often sharply separated from the walls, and, within, a ring of larger pali, which forms a central boss, visible to the naked eye. The formula seems to vary between those shown in Diagrams C and F, fig. 3 (p. 19). There is a small columellar tubercle, but all the elements seem to thicken rapidly, closing up the openings into the calicle. The fossa is therefore not deep or conspicuous. The small interseptal loculi are, however, deep and regular close round the wall.

The section shows a streaming central flaky core, round which rather thin trabeculæ radiate regularly outwards; the latter are not very compact, and appear somewhat lamellate, especially as they leave the central core. The colour appears to have been a creamy yellow.

The growth-form of this coral is interesting. There appears to have been no encrusting base, but the streaming layer of the skeleton seems to have carried the stock up irregularly into clusters of expanding ridges. The whole growth-form seems to be a complication of the expanding sheaf formation. Other specialisations of this have already been seen in *P. Singapore 2*, *3*, and *5*. It is interesting to find so many *Porites* in this locality, for only one *Goniopora*, showing this specialisation of the skeleton. For other *Porites* showing traces of the same kind of growth, see Table III.

a. Zool. Dept. 78. 6. 6. 6.

189. **Porites Singapore** (7)**7**. (*P. Singaporensis septima.*) (Pl. XXVIII. fig. 7; Pl. XXIX. fig. 1.)

[Singapore,* coll. Raffles Museum; British Museum.]

Syn. *Porites saccharata* Brüggemann, Abh. Nat. Ver. Brem., v. (1878) p. 545.

Description.—The corallum rises on a stalk into a close tangle of thick flattened stems, which bend and fuse together freely. The branchlets at the surface are long, thin, digitiform, and forking; they point in all directions, and fuse together at all angles. They are 3–4 cm. long and about 1 cm. thick. The living layer may extend some 12 cm. deep, and its lower edge tends to creep downwards.

* Specimen *b* with slightly different characters is from West Singapore. It is possible that they are all from the same locality.

The calicles are very shallow and inconspicuous, uniform in size, 1·25 mm. The walls have a median ridge, tracing a polygonal pattern over all the upper parts of the colony, but gradually disappearing below. Its texture is an irregular lamellate lattice-work, the top edge of which is here and there frosted and bent over for the formation of a fresh layer of horizontal flakes. This median ridge stands upon flakes, which are small and like the scales of Lepidoptera in the upper parts of the colony, but broad flat sheets in the lower parts, where the median ridge disappears. The tongue-like septa at different levels fill up the calicle round the fossa, greatly obscuring the interseptal loculi. The pali are fairly regular, and form a boss visible to the naked eye; the formula is frequently complete, eight in number (Diagram B, fig. 3, Introduction, p. 19). The fossa is large and very frequently deep and open, visible like a pin-hole to the naked eye.

The section is remarkable. The axis is occupied by a wide-meshed, very pronounced, lamellate reticulum, round which thin trabeculæ, rather far apart, run through wavy, concentric, but interrupted, rings of skeletal matter, leaving large meshes.

Traces of colour suggest a light brown tinged with olive-green.

The original large specimen of this coral (*a*), described by Dr. Brüggemann, is in the British Museum, having been purchased from the dealer, Gustave Schneider, in Basel. There is a small fragment in the Hamburg Museum, which Dr. Rehberg* thought was the original. It is possibly a detached branchlet of the large specimen.

In addition to *a*, there are fragments from the Raffles Museum. One of them, *b*, from West Singapore, shows the same method of growth and section, but the flakes do not form quite the same pattern as in *a*, but are arranged more as a flaky reticulum.

a. Zool. Dept. 78. 4. 1. 3.
b. Zool. Dept. 93. 7. 22. 19.
(*c* is a box of small fragments of *a*.)

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190. MERGUI ARCHIPELAGO.

[Though topographically this belongs to the Indian Ocean, a glance at the map shows the island-group joined on to the Malay Archipelago. The faunistic evidence confirms this view.]

The specimens of *Porites* collected by Dr. Anderson from this locality are all preserved in the Indian Museum, Calcutta. They were examined by Duncan,† who states that "the genus flourishes at Mergui." He records three forms which were apparently true *Porites*.

1. One from Elphinstone Island, thought by Duncan to be a variety of that called *Porites conglomerata* by Quoy and Gaimard in the Voy. de l'Astrolabe, Zooph., p. 249, pl. 18, figs. 6–8,

* Hamburg Abhandlungen, xii. (1893) p. 48.
† Journ. Linn. Soc. Zool. xxi. (1889) p. 20.

and included in a group called *P. Gaimardi* by Milne-Edwards and Haime (see above *P. Queen Charlotte Islands, 1*, p. 82). As this latter coral came from Vanikoro, nothing is gained by claiming the Mergui form to be of the same species without giving the evidence on which that conclusion is based.

2. A form which Duncan compared with the Red Sea *Porites* called *nodifera* by Dr. Klunzinger. The description and photographs of the latter author * supply far better material for comparison than those of Quoy and Gaimard; we can thus obtain a better idea of this coral than we can of No. 1. It was from King Island Bay.

3. This was a cœnenchymatous *Porites*, also from Elphinstone Island, and compared by Duncan with the coral figured by Dr. Klunzinger as *Synaræa lutea* on his pl. v. fig. 29, pl. vii. fig. 4.

One other form was called by Duncan *Porites excavata*, on the supposition that it is the same species as one described under that name by Dr. Verrill from Panama Bay. The latter coral, however, appears to have been a *Goniopora*.

JAVA SEA.

191. Porites Java Sea $_{(2)}$1. (*P. Javanica prima.*)

[Just to the east of Liotjitjangkang (long. 107° 28′ E., lat. 7° 3′ S.).]

Syn. *Porites strata* Martin, Die Tertiärschichten auf Java (1879–80) p. 147, pl. xxv. fig. 13; see also the Map, locality P.

Description.—The corallum is built up of encrusting layers, 2 mm. or less thick; surface smooth or slightly wavy.

The calicles are 1 to 1·5 mm., always polygonal and mostly hexagonal. The walls are conspicuous, sharp-ridged, porous, faintly granulated. There are twelve septa, and five to six well-developed pali, with a variously developed but smaller columellar tubercle.

The photograph of this specimen hardly gives enough detail to admit of closer description. No encrusting forms have yet been recorded from the coasts of Java, although there are doubtless many.

192. Porites Java Sea $_{(2)}$2. (Pl. XXVIII. fig. 8; Pl. XXIX. fig. 2.)

[Billiton, coll. Dr. Bolsius; British Museum.]

Description.—The corallum rises from a small encrusting base with thin, free, or pendent edges into a tuft of tall, sharp, smooth, round spikes, sometimes 20 cm. long, wavy, tapering

* Die Korallthiere des Rothen Meeres, ii. p. 41; pl. iv. fig. 13; pl. v. fig. 17.

gradually and forking at distances of 6 cm. apart. The spikes are 2-3 cm. thick near their bases, where they freely fuse together. The living layer may extend some 25 cm. from tip to base, where it may bend out as a free explanate sheet.

The calicles are 1 mm. in diameter at the tips; for 1 cm. down the sides they are hardly distinguishable, as they open in a pronounced flaky, porous reticulum, the flakes or filaments being everywhere smooth and chalky. A few larger pores, however, can be seen to represent fossæ. Below this, irregular low walls appear which are merely narrow raised portions of the flaky reticulum, with the flakes sometimes bent upwards, sometimes expanding horizontally, all the flakes with large round pores. Round the bases of the stems, the walls again tend to flatten down. The septa are very irregular, most frequently as broad flakes near the wall, but centrally tapering to thin points, which meet in twos and threes, uniting with a ring or with the parts of a ring, which runs round the fossa. A few smooth, slightly raised points occur where the septa meet, and represent pali. The interseptal loculi, sometimes oval, are mostly pointed near the wall. The fossa is either very deep and open or early filled with flaky reticulum from which an irregular central point rises.

The section shows an axis of very pronounced flaky reticulum round which both radial and concentric elements can be seen, but both of them are so flaky that they form together an alveolar tissue, the chambers being arranged in radial and concentric systems separated by smooth oval pores.

There is one large bleached specimen. It again shows the upgrowth of vertical lamellate trabeculæ which, in this case, run out into sharp spikes of great length. Again, also as in *P. Singapore 7*, the lamellate character of the vertical trabeculæ has been carried over both to the lateral radial trabeculæ and to the horizontal or concentric elements.

a. Zool. Dept. 83. 7. 24. 78.

Group IV.—INDIAN OCEAN.

193. **Porites Christmas Island** (4)**1**. (*P. Natalis prima.*) (Pl. XXVIII. fig. 9.)

[Flying-fish Cove Flat Reef, coll. C. W. Andrews; British Museum.]

Description.—The corallum is apparently massive, with wavy surface. [The only specimen is a small chip.]

The calicles are small, 0·75 to 1 mm. in diameter, shallow but sharply sunk. The walls are variable, here thick and reticular, there thin and membranous; in the latter case, straight and not zigzag. The component elements are extremely delicate and thin; the reticulum is

irregular, and seems to have a great many small square meshes, as if the filaments met at right angles. The septa are also extremely thin, and start well below the top edges of the walls, sloping inwardly and downwards. The pali are conspicuous, the four lateral principals being large and well developed. The directive pali are often very small, the ventral triplet being either fused or separate. Owing to the delicacy of the septa, the fossa and interseptal loculi are very open, and far down delicate skeletal strands can be seen forming an open columellar tangle, joining the pali and central tubercle together; the last named is very small, sometimes thin and flattened, and far down.

The section is trabecular, with a strong tendency in the trabeculæ to be lamellate. A rapid thickening takes place in the skeletal elements, so that the coral mass is a dense, close reticulum.

The colour is a light brown.

There is only a chip of some massive form, which Mr. Andrews says was very abundant and also very amorphous, taking on any shape according to its position. The skeletal elements of the surface are so fine and delicate that the coral has a soft woolly appearance. Such an appearance is seen also on *P. Bay of Panama 1*, but a comparision of the figures, Pl. X. fig. 3, Pl. XXVIII. fig. 9, shows them to be very different specialisations of the generic type.

This small specimen was referred to by me in the Proc. Zool. Soc. 1900, p. 123, and it was suggested that it might be related to *P. Ceylon 8*, which I had then proposed to call *P. Indica*.

a. Zool. Dept. 99. 5. 12. 25.

In addition to this chip from a recent form, said to be plentiful on the shores of the Island, there are a number of fossil fragments from the sea- and inland-cliffs. There is no apparent affinity between any of these fossils and the form just described. The former seem to fall into three groups, differentiated chiefly by the thickness of the walls. In the one set, the walls are thin and simple; in the other, reticular. The former seem to agree roughly with the group which Professor Gregory * called "*Porites aff. lutea* M.-E. & H." and the latter with Professor Gregory's "*Porites belli* n.sp."

The majority of the specimens are shared between these two divisions. In addition, there is a single specimen differing from these in that the polyp cavities are not traceable through the section.

The classification of recent *Porites* is based wholly upon the fine structural details of the calicles on the surface. These are lost in the vast majority of fossils, and only the sections remain to be compared. These can show no traces of surface characters, for not only is the relief gone, but the skeletal elements below the top surface are always secondarily thickened as part of the growth process. If it is difficult to enter into the specific relationships of the recent forms, it is quite impossible to pretend to any knowledge of those of fossil forms with no surface preserved.

* 'A Monograph of Christmas Island,' C. W. Andrews (1900) p. 206.

194. Porites Christmas Island (1)2. (*P. Natalis secunda.*)

[Sea Cliff, Rocky Point, North Coast * (Pleistocene), coll. C. W. Andrews; British Museum.]

Syn. *Porites aff. lutea* M.-E. & H." Gregory (*partim*), A Monograph of Christmas Island (1900) p. 222.

Description.—The corallum was massive; the calicles about 1 mm. across. The walls were irregularly reticular, about 0·5 mm. thick. The septal or intra-calicular skeleton had largely lost its primitive radial symmetry and become an open reticulum continuous with that of the walls. The fossa was frequently open and surrounded by a ring of tissue, but sometimes closed by a columellar tangle, that is by strands of the intra-calicular network.

The vertical section shows the polyp cavities running continuously through the mass; the trabeculæ are, nevertheless, not very pronounced, though more definitely continuous than the horizontal elements; the meshes are large and often rectangular, and the mass consequently very porous.

This is a very well preserved fragment, much weathered, and without any of the original surface preserved. The directions of the polyp cavities show considerable complexity of growth. The stock appears in life to have been rolled over. This should be compared with *P. Christmas Island 4.* The rectangular filamentous meshwork of the section is replaced in that form by a flaky reticulum.

a. No. 161. Geol. Dept. R. 3742.

Under this same heading I would include the fossil

No. 132.

[Second Inland Cliff, East Coast (altitude 550 feet), coll. C. W. Andrews; British Museum.]

Syn. *Porites belli* (*pars*) Gregory, l. c.

This is a very altered fragment, and the details are not easy to make out. But the walls are certainly reticular, as is also the intra-calicular skeleton, the latter losing thereby the sharpness of its radial symmetry. These are both important points allying it with *a.*

The fragment has been cut in half, and there is a microscopic slide.

b. Geol. Dept. R. 3744.

* This information is taken from Dr. Gregory's paper, p. 222.

No. 997 of Mr. Andrews' Collection.

[Southern Slope of the Island, altitude 350 feet.]

Syn. *Porites aff. lutea* (*pars*) Gregory, l. c.

The same melting down of the whole skeleton walls and septa is seen here again. The fragment is greatly solidified and altered.

The fragment has been cut in half, and there is a microscopic slide.

c. Geol. Dept. R. 3743.

Here also No. 853 appears to have a place.

[Shore Plateau at top of Sea Cliff, North-east Point, altitude 40 feet.]

Syn. *Porites belli* (*pars*) Gregory, l. c. fig. 7.

The fossil shows the two methods of alteration which frequently occur—either persistent walls without intra-calicular skeleton, or with walls decayed and the intra-calicular skeleton persisting as a solid prism. Other portions again seem to be well preserved, and show a continuous network which involves walls and intra-calicular skeleton in a very remarkable manner. The interspaces within the coral seem to have been very large, for they appear large in the section in spite of the fact that all the skeletal elements seem to have been secondarily thickened, either as a result of fossilisation or perhaps in life as a protection against the ravages of theboring alga. Whatever these suggestions are worth, what we seem to have is a reticulum with very thick smoothly rounded skeletal elements, and with large interspaces. These arrange themselves into calicles 1·5 mm. across, and without any traces of radial symmetry.

As all these particulars are given in some hesitation as to whether I have interpreted facts correctly, I place the specimen here rather than in a division by itself, although the large size of the calicles would seem to warrant such separate treatment. There are four fragments and a microscopic section.

d. Geol. Dept. R. 3728.

195. **Porites Christmas Island** $_{(4)}$**3.** (*P. Natalis tertia.*)

[From Inland Cliff over West White Beach, North-west, altitude 260 feet (Pleistocene), coll. C. W. Andrews; British Museum.]

Syn. *Porites belli* (*pars*) Gregory, l. c.

Description.—The corallum is massive, the calicles about 1 mm. in diameter and angular. The walls appear in section as simple threads or membranes, nodulated, and occasionally interrupted by pores. The intra-calicular skeleton is too confused to be made out clearly; it seems to be a loose, open reticulum within the thin, regular, smooth walls.

This specimen is greatly altered: it is hard, solid and crystalline, and again shows the same two methods of disintegrating. In parts the walls disappear and leave solid prisms running up through the mass, and in others the intra-calicular skeleton decays and the walls persist, thick and solid. In the microscopic section there seem to be clear traces of a boring alga having hollowed out the skeletal elements here and there, very irregularly, and it is known that such boring algæ do at times confine their operations to walls, sparing the septa (see Vol. IV. p. 53). I have not, however, seen a case before in which they attacked the septa and spared the walls.

There are the two halves of the original specimen (No. 306), and two portions of the slice out of which the microscopic slide was prepared.

a. Geol. Dept. R. 3730.

With this may be placed—

No. 609.*

[South of Flying-Fish Cove.]

Syn. *Porites belli* (*pars*) Gregory, l. c. fig. 6.

This is a large solid block, showing the same differentiation of the fossil mass as the last; only here and there, as in the part illustrated by Dr. Gregory, the skeleton is better preserved. The wall can be seen intact, and here and there thickened into a *regular* reticulum, that is by the formation of an inner synapticular wall, especially in the angles and spaces between the circular calicle and the nearly straight polygonal walls. Traces can also be seen of a ring of skeleton round the fossa. The radial symmetry of the septa is not very pronounced.

The microscopic slide shows well the ravages of the boring alga. Professor Gregory makes this remark of his fig. 7; but the real section of No. 853, which fig. 7 is intended to illustrate, is very difficult to understand, and while it does show the boring of the alga, the method of fossilisation has obscured the details in a way which I have not yet succeeded in unravelling.

There is one large block, and two portions of the slice from which the section was prepared.

In connection with this specimen, cf. 'A Monograph of Christmas Island,' p. 295, with fig. 4, p. 275. A gigantic mass of *Porites* between 20 and 30 ft. high is described by Mr. Andrews as exposed in this sea cliff. It may have been of the same kind as this.

b. Geol. Dept. R. 3748.

* Some confusion has crept into Professor Gregory's paper. His fig. 6 is said to refer to No. 609. This is correct; but No. 609 is accidentally given as No. 6 in his text. Then again it is stated that his fig. 7 refers to No. 6 of his text, but his No. 6 is a mistake for No. 609. It really refers, as the labels show, to No. 853. The method of illustration adopted is unfortunate, confusing rather than illuminating. (See Vol. IV. p. 120.)

No. 905.

[" From top of 1st Inland Cliff, South of the Waterfall."]

Syn. *Porites belli* (*pars*) Gregory, l. c.

The specimen is much altered, with tendency of the calicles to be weathered out. The special feature is the small size of the calicles, rather under than over 1 mm. (Cf. the recent *Porites Christmas Islands 1* (p. 190). No distinct plan of the original skeleton can now be seen, but stray traces here and there show for certain that the walls were thin, and composed of single threads. There is an appearance as if the skeleton had been hollowed out by some foreign organism, as is the case with so many stony corals.

The single specimen is cut in two.

c. Geol. Dept. R. 3740.

No. 165.

[Lower part of Sea Cliff.]

Syn. *Porites aff. lutea* (*partim*) Gregory, l. c.

The skeleton is traceable in the section, and seems to show another phase of the deposition of matter upon the original skeletal framework, so as in this case to fill up the cavities. The walls were thin and thread-like, and the specimen thus seems rather to belong to the group "*P. belli*" of Professor Gregory, than to "*P. aff. lutea*," in which it is placed in his paper (l. c.).

There are three portions of the specimen, and one microscopic slide.

d. Geol. Dept. R. 3746.

No. 301.

[Inland Cliff, altitude 250 feet.]

Over the greater part of this specimen only the walls persist, and their thread-like character can be easily made out.

The block is cut in two halves.

e. Geol. Dept. R. 3745.

No. 128 and No. 358.

[? exact localities.]

Two more specimens, the latter of which comes nearest in general appearance and internal character to No. 609. In No. 128, the original texture has almost entirely disappeared.

In all, four fragments.

f–g. Geol. Dept. R. 3756, and R. 3747.

There are other fragments, as to which it is impossible to say whether they are or are not representatives of this genus.

196. Porites Christmas Island (4)4. (*P. Natalis quarta.*)

[Rocky Point, Sea Cliff (Pleistocene), coll. C. W. Andrews; British Museum.]

Syn. *Porites aff. lutea* (*pars*) Gregory, l. c. fig. 5.

Description.—The corallum is massive. The calicles are obscure; the wall reticulum and the intra-calicular skeleton melted down into a reticulum in which it is difficult to distinguish the one from the other, and thus the calicles themselves are obscured. There is no radial symmetry to indicate their presence. The sections and worn faces show a uniform, open, irregular, flaky reticulum, though trabecular elements appear whenever the section is vertical.

This specimen was placed by Professor Gregory among those he named "*P. aff. lutea.*" It is true that all of them are massive, and the whole skeleton is melted down to a reticulum, but in this case the section is an undifferentiated flaky network; the polyp cavities are not seen running through it, indeed, they are quite undiscoverable: this differentiates it from both *P. Christmas Islands 2* and *3*. The published figure given by Professor Gregory from a section is not truly horizontal, but cuts through the calicles at an angle of 45°.

The original specimen has been cut in two, and there is besides a microscopic slide.

a. Geol. Dept. R. 3712.

KOKOS OR KEELING ISLANDS.

From these Islands there is but one minute fragment of a branching *Porites* in the collection, presented by Dr. H. O. Forbes. It is of interest not only because it calls attention to these coral Islands, which must be rich in forms of which we still know nothing, but because the aspect of the calicles is instructive. The granules which rise within the calicle are seen as rounded knobs, but those on the wall are flat, horizontal flakes (see Pl. XXX. fig. 1). The section shows the radial and concentric elements about equally stout.

a. Zool. Dept. 84. 2. 16. 49.

CEYLON AND GULF OF MANAAR.

The Museum possesses a specially fine collection of *Porites* from the Gulf of Manaar which it owes to Mr. Edgar Thurston, Director of the Madras Government Museum. The bulk of them are from Ramesvaram, and may be divided as follows:—

Sixteen specimens forming a very valuable series, and all showing the same peculiarity of growth-form.

Seven specimens from the Pearl Bank, and all growing on the Pearl shell (*Margaritifera vulgaris*).

Three specimens from the sub-fossil reef described by Mr. Thurston in the Bulletin of the Madras Government Museum, No. iii. 1895, pp. 91-93.

The Ramesvaram Series.—These corals without exception are massive, but show the following strange method of growth. The earliest colony starts from a small base, often a branch of a *Madrepora* or a piece of a dead Astræid. Above this base it swells into a knob continually increasing in size without being able to widen its base of attachment. This knob eventually becomes top-heavy and breaks off. Fallen on its side, the stock then presents a solid and more extensive base for its own future growth; upon and above this fallen stock the colony both rises in height and swells out rapidly in circumference. These lateral swellings often stand out parallel with the substratum on all sides like a flat resting base, or even droop down on all sides like a thick curtain, but in neither case does the colony again adhere to the substratum. This applies to all the forms from No. 1 to No. 9, even though their calicles show them to be very different corals, and though their growth-forms are also very different. It would be interesting to ascertain what it is in the character of the surface which prevents these corals from adhering. The phenomenon at once suggests the presence of sand or mud.

With regard to the division and grouping of the specimens themselves, we are met by many great difficulties, owing to the variations of the calicles on one and the same specimen, and of the details of growth-form in the different specimens. We have fairly clear evidence that these two—calicles and growth-form—are largely interdependent, but which comes first and conditions the other we do not know.

197. **Porites Ceylon** (22)**1**. (*P. Ceylonica prima.*) (Pl. XXX. fig. 8; Pl. XXXV. fig. 29.)

[Ramesvaram, coll. E. Thurston; British Museum.]

Description.—The corallum is a large, flat, oval mass, detached and resting on one side. The surface is lobulate or dimpled, according as the low rounded eminences, which are 3 cm. in diameter and 0·5 cm. high, are distinct or crowded. The living layer is 14–15 cm. deep and bends 5–6 cm. under the flattened base. The specimen is 30 cm. long, 20 cm. broad, and 16 cm. high.

The calicles are 1·5 mm. across, flush with the surface, faintly pitted and inconspicuous. The walls are hardly raised, and consist of a fine very delicate reticulum which is neither filamentous nor flaky, with small pores. The reticulum is often regular, consisting of a jagged irregular median ridge with synapticular walls on each side of it, and separated from it by regular rows of pores. Down the sides and on the under surface, the reticulum is irregular, being thicker and of stouter elements with smaller pores. The septa are very short, and lose themselves in an immense columellar tangle, in the structure of which traces of concentric

rings can be perceived. When these rings do not rise quite to the surface, spike-like synapticulæ can be seen on the sides of the septa as if about to meet and complete the rings. There is very rarely any open fossa, and there are no pali. One, two, or three of the interseptal loculi are very large and conspicuous, as if to compensate for the absence of fossa.

This specimen must be studied in comparison with others of the series.

In No. 2, the same kind of calicles are found on the rather smooth out-curving basal rim, which consequently has the same soft, woolly appearance as this coral; but above this rim, the calicles and the character of the surface change completely.

In No. 3, the basal rim and all the dead previous growths hidden under the base were of this same growth-form and with the same type of calicle formation. The calicles of the great stock above them change in the direction of those of No. 2, but never completely resemble them.

Compare also the calicles of this with those figured for No. 6 (Pl. XXX. figs. 7, 8).

a. Zool. Dept. 1904. 10. 17. 43.

198. **Porites Ceylon** $_{(22)}$**2**. (*P. Ceylonica secunda*.) (Pl. XXX. fig. 3; Pl. XXXV. fig. 30.)

[Ramesvaram, coll. E. Thurston; British Museum.]

Description.—The corallum, after the decay of the original base, rests free as a large column upon a disc-like basal rim slightly curved outwards. The nearly vertical sides are roughened all over by processes; the small ones are mere rounded swellings, but they gradually change as they grow into stout vertical plates or short ridges with sharp edges. The top is irregularly flat, and consists of a crowd of short, sharp ridges, of all sizes arranged in every direction and fusing together freely. Between their steeply sloping sides are crevasses from 1 to 5 cm. deep.

The calicles are minute, the largest 1 mm., many as small as 0·5 mm.; shallow but distinctly pitted, angular on the top but circular on the lower half of the sides of the stock. The walls on the top are continuous smooth threads, very stout in comparison with the size of the calicle; they stand a little above the general surface, and are nearly straight, showing a very slight tendency to be zigzag chiefly in the alternation of the septal points on each side. Down the lower half of the sides a tendency to form parts and then the whole of an inner synapticular wall appears, until on the upper surfaces and sides of the basal rim the calicles are exactly like those of the form last described, even with the large columellar tangle and the few enlarged interseptal loculi. The septa in the normal calicles come straight off from the walls as short, stout rods, which, when forming the lateral pairs, meet immediately in a blunt angle of nearly 60°. The directives are very short. There are no pali, or only slight indications of them in some of the lower calicles. There is a short, thick, flattened columellar tubercle. For the details of the lowest calicles, see the preceding form.

The section shows a very close arrangement of stout trabeculæ separated by rows of minute pores. The colour is a dull buff.

No two calicles could be more unlike than those on the top of this hard, dense mass and those on the soft-looking, rounded stock presented by No. 1. And yet here the same soft, woolly look and the same calicles as those of No. 1 appear on the basal rim of this column.

a. Zool. Dept. 1904. 10. 17. 44.

199. **Porites Ceylon (22)3.** (*P. Ceylonica tertia.*) (Pl. XXX. fig. 4.)

[Ramesvaram, coll. E. Thurston; British Museum.]

Description.—The corallum has the same widely outspread unattached base, under the middle of which are the decayed remains of earlier stocks. Above this base, with its slightly projecting rim, the mass rises into a narrowing column of erect processes of all sizes, from minute knobs and points to tall, stout, flattened ridges, blunt points, or angular knobs, some of which are as much as 15 cm. high, 7–8 cm. across, and 3–4 cm. thick.

The calicles over the greater part of the stock are like those halfway down the sides of No. 2. They are larger and rounder than the topmost calicles of that specimen, but again gradually change round the base into those characteristic of No. 1. Here and there the walls return to being single threads. At the tops of the processes the calicles open irregularly, a streaming reticular layer, loose, open, and flaky-filamentous. The sections show remarkable differences of density. Where the calicles are smallest and most like those of No. 2, the trabeculæ are closely packed, but where the calicles are like those of No. 1, they are separated by rows of much larger pores.

This specimen is of peculiar interest, because it seems possible to trace a distinct correlation between the type of the calicle and the forms of the rising processes. Where the calicles are like those of No. 1, or approach that type, the processes are rounded, thick, and softer looking. Where they are like those of No. 2, the processes tend to narrow into hard ridges.

It is worth pointing out that the corroded remains of previous growths found embedded under the base of this great specimen still show quite clearly, both in shape and texture, that they were at one time like No. 1.

a. Zool. Dept. 1904. 10. 17. 45.

200. **Porites Ceylon (22)4.** (*P. Ceylonica quarta.*) (Pl. XXX. fig. 5; Pl. XXXV. fig. 31.)

[Ramesvaram, coll. E. Thurston; British Museum.]

Description.—The corallum expands with a wide, thick, cushion-like edge, deeply incised and pendent, freely above a loose cluster of small rounded stocks of apparently the same

coral. Above, the mass is a cluster of large, smooth, rounded knobs, up to 4 cm. across and 4 cm. high, slightly flat-topped, and, as they only swell gradually, with steep sides. Between these knobs flat spaces of dead coral are seen, and sometimes openings into the heart of the stock. Though the living layer of the uppermost knobs is only some 4 cm. deep, at the sides it may be 12–13 cm., and even bend sharply 2 cm. under the edge.

The calicles are 1 mm. in diameter, neatly circular, shallow, but very distinct. The walls are conspicuous but low, thin, and often only thickened in the angles sufficiently to make the calicles circular. At the thinnest seen from above they are single, rough, uneven threads, and are thickened by a tangle of similar threads as an irregular reticulum. In the lower parts of the stock these irregularities in the threads swell into rough granules. The septa are also thin and rough and symmetrically arranged, but their top edges are very ragged and incomplete. The pali are very faintly developed in the calicles on the flat tops of the knobs where the elements are specially thin, but down the sides they rise as small rods, themselves insignificant, but together forming a raised ring visible to the naked eye (Pl. XXX. fig. 5). The full number, eight, is usually present. On the lower parts of the stock the skeleton is all more granular, and the intra-calicular skeleton may be but an arrangement of rough granules. The central tubercle is often flattened. The columellar tangle seems to be very large, the roughness of the septa growing out into synapticulæ even close up against the wall.

The section shows a delicate texture with very thin skeletal elements, the trabeculæ being arranged sheaf-like in a section through a knob. The colour is a light buff or brown.

This is the description of a very large specimen, 30 cm. across and 20 cm. high. In growth-form it is somewhat like that described under the next heading, but the knob formation is bolder and the calicles are different. It is possible, however, to connect the two specimens by assuming that in No. 5 the trabecular elements are laminate and of more rapid growth.

There are two younger specimens, *b*, *c*, both showing the same type of calicle. In *b* the calicles show hardly any difference from those of *a*, but its growth is peculiarly interesting. Its dead pear-shaped stalk narrows smoothly towards where it was broken off, showing its earliest growth like one of the knobs seen on the top of *a*, of the same size and shape. Later growth has swelled this into a flattened mass, 12 cm. in diameter, and with thick rim, and with a convex, convoluted top, 9–10 cm. high above its thick projecting rim. The convolutions admit of being resolved into a cluster of fused knobs like that of its very earliest growth, and now seen rising all over the upper surface of *a*.

In *c*, while the growth-form is somewhat like that of *b*, the calicles, though of the same type and texture, have very high walls, and thus form a transition between those of *a* and those of the next form, No. 5. The growth-form of *c* is a convex mass with bold wavy surface, and growing on the under surface of a similar mass which had been turned completely over.

a. Old stock. Zool. Dept. 1904. 10. 17. 46.
b, *c*. Young stocks. Zool. Dept. 1904. 13. 17. 47 and 48.

201. **Porites Ceylon** (22)**5.** (*P. Ceylonica quinta.*) (Pl. XXX. fig. 6.)

[Ramesvaram, coll. E. Thurston; British Museum.]

Description.—The corallum grows out, as a flattened lobulated mass, with free horizontal base, from the side of an overturned mass of the same shape. Its upper part is divided into large fused knobs, each with its surface divided into much smaller lobules. Between the large knobs the cavities run down into the heart of the stock. The living layer on the outside is some 8 cm. deep.

The calicles are small, under 1 mm., deep, and angular; here and there, where walls are thick, they are neatly circular. The walls are mostly very thin, membranous, and porous; in the angles they dissolve into an open filamentous reticulum. The septa are very thin, smooth, and lamellate, symmetrically arranged, and spring rather high up from the walls as far as the septal granules, after which they drop down. The pali rise as high as the septal granules, and surround a large fossa with a ring of eight, only the four lateral principals being really developed. The columellar tangle is well developed, and reticular. The central tubercle is thin, and flattened in the directive plane. In the calicles round and under the rim, the walls are a thick, ragged, open, filamentous reticulum; the septa tend to be echinulate.

The colour is light brown; there is no visible section.

In the observations on No. 4, it is suggested that laminate trabeculæ may be associated with great rapidity of growth, the elements then being smoother and the walls taller, and if so this might account for the differences between this coral and No. 4. But even then it is not easy to see how these variations would account for the differences in growth-form. The form No. 7 has calicles somewhat of the same pattern as those of Nos. 4 and 5, but with very tall walls, the growth-form being also entirely different.

a. Zool. Dept. 88. 11. 25. 7.

202. **Porites Ceylon** (22)**6.** (*P. Ceylonica sexta.*) (Pl. XXX. fig. 7.)

[Ramesvaram, coll. E. Thurston; British Museum.]

Description.—The corallum forms perfectly smooth, rounded, or ovate masses, which appear to roll over and find attachments to loose objects, enveloping foreign bodies by thick creeping edges of the living layer. The gradually dying sides are covered over by a conspicuous white epithecal film.

The calicles are 1·25 mm. (with frequent double calicles, 2 mm.), flush with the surface, symmetrical, and star-like. The walls are a mere thin, straggling, polygonal thread, irregularly joining the ends of the septa, often interrupted, and not appearing at the surface at all. At

the sides and slopes the walls thicken into a straggling, open reticulum, the threads of which run on into the septa. The twelve, sometimes very distinct, septa appear at the surface either as slightly echinulate or granular threads, which here and there are continuous across the wall with septa of the adjacent calicles, or as rows of granules, in which case the whole surface is composed of uniform points, among which the calicles are sometimes difficult to trace. The central fossa is nowhere conspicuous, because it is not sharply circumscribed by any regular ring, and may be further obscured by a central granule. The paliform granules are present, but not conspicuous above those along the edges of the septa. All the granules are frosted, or rather bluntly echinulate. All the interspaces are large, so that the surface texture, especially of the top, is loose and brittle.

The only visible section (from a broken lower edge) shows regular trabeculæ joined together by very thin junctions, leaving rounded or oval pores. The colour appears to have been an ash-grey.

There is one large perfect specimen, 16 cm. long, 9 cm. across, and 9 cm. high. It appears to have been originally attached to an Astræid. Its skeletal pattern is so far unique. Two minute specimens, apparently of the same kind, but since accidentally destroyed, were at one time seen attached to it by their epithecal saucers, under 2 mm. in diameter, and containing about three calicles each. These were of great interest, the texture of their skeletal elements being very like that of this type, but the calicles were very much smaller (0·5 mm.). This last fact raises a doubt as to whether they really were young colonies of this form or not. I have certainly noticed before that very young colonies have smaller calicles than the larger forms to which they *seem* to belong. If this is so, it helps to establish the fact of the very early budding to which I would attribute the structural features typical of the genus.*

Compare the calicles with those of No. 1 (Pl. XXX. fig. 8).

a. Zool. Dept. 88. 11. 25. 16.

203. **Porites Ceylon** $_{(22)}$**7.** (*P. Ceylonica septima.*) (Pl. XXX. fig. 2; Pl. XXXV. fig. 22.)

[Ramesvaram, coll. E. Thurston; British Museum.]

Description.—The corallum is globular and free, with boldly convoluted surface, the ridges being rounded, but with a tendency to form crests. They are about 2 cm. high, and the valleys are open. The stock started originally on a branch of *Madrepora*, but that support broke and left it free. The last living layer extends 9 cm., or half-way down the sides of the globe.

The calicles are slightly over 1 mm., deep and conspicuous. On the tops of the uppermost ridges they appear in a loose, open reticulum of delicate filaments and laminæ. The walls in these places are reticular, with clear traces of vertical membranes, the meshes and pores of

* See Introduction, p. 24.

which are large, and all the elements are smooth and thin. Down the sides the elements thicken, and become rows of sharply defined granules, the walls usually consisting of a single row, with all stages in the appearance of a second by the formation of an inner synapticular wall. The septa are clear, sharp, thin, and lamellate, but in the lateral calicles they thicken, and both septal granules and pali appear, the latter usually in the complete formula of eight. A large, irregularly reticular columellar tangle can usually be seen high up in the fossa, and from it a small granular tubercle arises. The interseptal loculi are very large, round, and open in the uppermost calicles, while their star-like radiation in the lateral calicles is visible to the naked eye.

The colour is brown.

This coral is quite different in its calicle formation from any of those hitherto described. It is impossible, in the present state of our knowledge, to say whether the differences are in any way due to the modifications which the colony had to undergo in adapting itself to such a small foothold as a thin branch of a *Madrepora*.

On the under surface there are calicles which may have been alive when the stock was found, but which did not belong to the last growth-period, the edges of which can be traced. These appear to have grown in this same unfavourable ventral position, for they have very thick, solid walls, composed of a compact mass of large granules, while large septal granules, pali, and tubercle fill up the calicle.

There is one other quite free stock in the series (see No. 9). Almost all of them without exception were in reality free, but rested on broad flat bases. This and No. 9 were apparently rolling, unless the remains of the *Madrepora* hindered this one, and this is probable, for there are signs of the formation of a thick, cushion-shaped rim for the production of a resting base.

a. Zool. Dept. 1904. 10. 17. 49.

Five of the remaining specimens may, with some certainty, be placed together. Their growth-forms require describing, but the calicles are all variations on one type, and most of the variations can be found on each specimen.

204. **Porites Ceylon** (22)**8.** (*P. Ceylonica octava.*) (Pl. XXX. fig. 9.)

[Ramesvaram, coll. E. Thurston; British Museum.]

Description.—The corallum stands upon some small object, round which its own base spreads freely all round with a very thick, chalky epitheca. Above the cushion-shaped edge the stock rises into great masses of various shapes, but all showing a tendency to column formation, which may be so compact that the whole is a cylindrical mass, with vertical flutings round the sides, the tips of the columns showing more or less separate only on the top.

The calicles are very variable in size, from 1·2 mm. down to the minutest buds; they are shallow, and, according to the character of the wall, either circular or very angular. The

latter are often the deeper. The wall varies greatly. It is frequently—e.g. on the growing tops of stocks—very thin, zigzag, incomplete, and ragged. The angles between calicles are nearly always thick and reticular, and raised buds are frequently to be seen upon them. Down the sides the walls are thicker, and may become reticular, and in two ways: we may have either a more or less regular filamentous reticulum with persistent septal symmetry, or a very ragged, flaky reticulum, not very thick, but with the septa running out as narrow, jagged, and twisted flakes, the septal system then forming an irregular reticulum across the calicle. Again, on still lower parts the wall may be a thick, solid mass of granules, and the septal system also a compact mass of granules when seen from above.

The septa are very thin, straight, and regularly arranged in the thin-walled calicles; their edges are irregular, but septal granules and pali appear in all degrees of conspicuousness. Where the septal system is an irregular network, these latter are not developed at all; but where the walls are filamentous, they depend upon the thickness of the elements, and may be regular rings of knobs or flattened plates visible to the naked eye, or almost vanishing points quite irregular in their appearance. The distance between the septal granules and pali may be large enough to make the latter appear as a central boss standing up from the floor of the shallow calicle. When the elements are thickest, the two rings of large granules, with the larger central tubercle, may fill up the whole calicle.

In the ordinary calicles the central tubercle is frequently deep down and obscure.

The section shows a fine, dense arrangement of thin trabeculæ, separated by comparatively large, round pores, but all small and delicate. The sheaf-like arrangement of the trabeculæ in the formation of the knobs and columns may be conspicuous; even a solid block may be seen in section to consist of a compact mass of such sheaves, each of which, however, forms an eminence on the top surface. The colour is a brown or fawn.

In this group are some of the finest specimens in the collection.

a. Was originally attached to a decayed *Favia*, from which its base spreads out laterally on all sides, 7 to 15 cm. The sides ascend steeply and smoothly for 24 cm. Assuming that column formation is the principle of structure, we may note that in this form they were large, thick, and smooth. They are fused so compactly that the sides of the stock are fluted, as much as 3 cm. deep and 7 cm. apart on one side, the flutings standing out as blunt keels, which, however, may break up into so many separate knobs or eminences.

The calicles on the flat top, which shows only slight traces of the column formation, are all with thin, incomplete, zigzag, filamentous walls. There are a great many double calicles, among which, now and again, as many as four calicles fused in a row may occur.

The base of *b* rests upon quite a small mass of a previous growth, a vertical section of which shows that the mass consisted of a dense cluster of sheaves of trabeculæ, the top of each sheaf forming a rounded knob at the surface. Above the base, which is nearly 40 cm. across, and with its thick, turned-out, cushion-edge, the mass rises into a truncated cone of erect, flat-topped columns all fused together below, but with their tops often 6 cm. or more as free projections. Each column is itself covered with slight bulgings, as if they were the beginnings of a similar column formation.

c. Is much smaller than either *a* or *b*. Its sides are more nearly vertical, like those of *a*.

One side shows a tendency to form the long, smooth, vertical ridges as in *a*, while the other is covered with knobs like those of *b*, but not yet developed into pronounced columns.

d, *e*. Differ from the foregoing in bulging out all round above the wide flat bases, and forming thickening columns with flat or convex tops; these are broken up into hundreds of irregular, rounded and ridge-like tips of small component columns. The sides are irregularly fluted by rows of small eminences, ridges, knobs, or even points sloping upwards. The growths differ from any of the foregoing, inasmuch as the original stocks grew to some size and had sent up clusters of columns before the pendent crinoline-like edge hung round them. In all the other growths the edge started out very early when the primitive stock was small, and grew out horizontally; in this case the original stock was coated over by successive creeping layers before the side itself came down as a thick cushion edge, alive with calicles on both sides.

There is a large vertical section of specimen *d*, showing that the sheaf arrangement of the trabeculæ has something to do with this growth-form. It is a complete sheaf system, which bends round and down to form this thick, hanging edge.

The calicles on the tops of both these specimens are opening in a fine, ragged, flaky reticulum, in *d* more regularly than in *e*, in which much undifferentiated reticulum occurs. In both, the pali form a central boss in the very shallow calicles.

a–e. Zool. Dept. 1904. 10. 17. 50–54.

205. **Porites Ceylon** (22)**9.** (*P. Ceylonica nona.*) (Pl. XXXI. fig. 1.)

This series ends with a loose, lenticular fragment like a pebble, which appears to have lived as a detached colony. Every part of it seems to have been alive, for though the calicles are all flush with the surface, there is no sign of any part having been worn down as a pebble, nor is there any means of knowing on which side it last rested.

This detached method of life may quite alter the characters of the calicles. There are no means now of connecting the specimen with any of the forms so far described as from this locality.

The walls are broad, slightly rounded, without any trace of median keel; they consist of a very flaky reticulum, the flakes lying horizontally, with minute pores. On one surface (? the one last uppermost) the skeleton is covered with frosted granules which emphasise the septal skeleton. This shows a ring of septal granules and a ring of six pali with a columellar tubercle. In the absence of these granules the septa are flat, smooth, and flaky, and the calicles appear as rings of small interseptal loculi. Round the rim of the lens-shaped stock the flaky reticulum is more open and delicate, and as it runs into the calicular skeleton it tapers along the smooth but incised septal flakes into the finest filaments, which run together to form an irregular columellar tangle.

Nothing can be concluded as to the shape of the original stock from which the specimen became detached. There is no sign of any fracture.

a. Zool. Dept. 1904. 10. 17. 55.

A second series of *Porites* from Ramesvaram is a group of seven from the Pearl Bank. They are all attached to the upper shells of the pearl oyster—*Margaritifera vulgaris*. There is no means of associating them with any of the forms above described. We do not know

whether fixation to the pearl shell in any way modifies the characters, nor whether local races always attached to these shells may not have come into existence. We have then nothing to do but to group the specimens according to their resemblances. They show three clear variations.

206. **Porites Ceylon** (22)**10.** (*P. Ceylonica decima.*) (Pl. XXXI. fig. 2.)

[Ramesvaram, Pearl Bank, coll. E. Thurston; British Museum.]

Description.—The corallum completely covers the shell, often, indeed, overhangs it with steep, bulging sides. It is 2–3 cm. thick, and forms a smooth or faintly wavy convex mass, often with one long, blunt ridge running across it, but not through the centre.

The calicles are polygonal, nearly flush with the surface, faintly pitted, slightly over 1 mm. in diameter. The walls are either thick, continuous, wavy threads, or here and there tending to divide up into the irregular, concentrically flattened tips of the trabeculæ. Within this is an inner ring, which may be either a thick thread separated by large pores from the true wall-thread, or else flaky, showing all degrees of flakiness until down the steep sides of the stock the whole wall may consist of broad, flat flakes. The septa appear short when starting from the synapticular ring, but most of them come from the wall, and they all join a large, nearly complete, columellar ring round the fossa. They are smooth and symmetrically arranged, but angular and bent. There is mostly a ring of septal granules rising to the height of the wall from the points where the septa cross the synapticular ring, and also a ring of pali not quite so high, and very frequently only the five principals. They are angular granules, and may be conspicuous to the naked eye. The fossa is either very deep, or the columellar ring fills up with cross bars, from which a small flattened tubercle may arise. The columellar ring, the synapticular ring, and the wall form three concentric rings, the first-named being most nearly round. The interseptal loculi are small, and with uneven edges.

The colour is a warm, dark buff.

There are three specimens, having calicle skeletons of the same general construction, which seems to show that they are closely allied. Specimen *a* has thick, thread-like walls and thread-like synapticular ring, with open fossa, though here and there the wall is thinner, and tends to divide into trabecular points. Very thin, discontinuous walls, with inner wall breaking up into flakes or knobs, is the characteristic of specimen *b*. In *c* the wall-thread seems to be thicker, and tends, with the synapticular wall, to be a stout, regular reticulum with regular oval pores. On all the specimens the tendency of the synapticular walls to be broad, flaky shelves, is seen on the steep sides.

a, *b*, *c* (in box). Zool. Dept. 90. 6. 12. 15.

In parts of *a*, where the wall points have been broken off, they can be seen hollowed out by an alga. This presence of the alga on the very tips of the skeleton nearest to the surface has already been noted.

207. **Porites Ceylon** $_{(22)}$**11.** (*P. Ceylonica undecima.*)

[Ramesvaram, Pearl Bank, coll. E. Thurston; British Museum.]

Description.—The corallum is like the last, but more smoothly convex.

The calicles are pitted and conspicuous. The walls are reticular, very irregular in thickness and texture, the reticulum being fluent—that is, with no traces of any formal arrangement of the elements. The pores are smooth, round or oval. The reticular character of the walls extends to the intra-calicular skeleton also, which loses almost all traces of radial symmetry, and is seldom at the same level across any calicle. All the superficial parts of the calicle skeleton can be seen, but confused; stray septa, a few pali, a columellar tangle, large interseptal loculi, can all be made out, but with so little symmetry that the skeleton appears to be a confused tangle.

This specimen is puzzling; it looks as if it might be a weather-worn specimen of the last form. Perhaps the shell had long been cast away in the Pearl Camp. The same elements can be seen in the two, but in this the finer surface details may have been lost. The walls stand up, and the calicles are very irregularly deepened, as if the deepening might have been due to the irregularity of the weathering.

The greater fluency of the wall reticulum and the increased irregularity of the calicular skeleton, however, are differences of importance, and even though the skeleton has lost the glassiness of fresh material, and shows the opacity and chalkiness of a weather- or water-worn coral, the fine details of structure are so well preserved as to justify the belief that we still have the original surface.

a. Zool. Dept. 90. 6. 20. 8 (part).

208. **Porites Ceylon** $_{(22)}$**12.** (*P. Ceylonica duodecima.*) (Pl. XXXI. fig. 3; Pl. XXXV. fig. 17.)

[Ramesvaram, Pearl Bank, coll. E. Thurston; British Museum.]

Description.—The corallum not only encrusts the upper surface of the pearl shell, but may even send out free, explanate edges 2 cm. beyond it. The topmost surface tends to rise into irregular mammillæ about 1 cm. high and 1 cm. thick. The free edges are thin, 1 mm., tend to droop, and even to fold under.

The calicles are small, from 0·75 to 1 mm. across, deep, and as if punctured into the surface, though not neatly, but with ragged, irregular edges. The walls are of very irregular thickness; they thicken in small groups, which then tend to rise up and form the mammillæ; the wall at its thinnest consists of a single, very irregularly zigzag lattice-work, and at its thickest of an open reticular arrangement of such a lattice-work, which may be simply a stout reticulum, or have an appearance of flakes curving outwards into the horizontal. The vertical elements may also appear as flakes, the edges of which stand sharply up either as a reticulum or crossing the top of the wall as thin striæ, mostly, but not always, radially arranged.

The septa are very thin, and so perforated as to appear like filaments, which start very irregularly and at very different levels from the walls. The intra-calicular skeleton is thus very ragged and irregular; only when seen straight from above can its symmetry be made out. The five rod-like pali, which the septa irregularly join, reach nearly to the height of the wall. The columellar tangle either forms a ring round the large, deep, open fossa, or else fills it up with skeletal tissue.

There are, unfortunately, no available sections; the colour appears to have been a brown, with a red or purple tinge.

There are three specimens, all showing essentially the same skeletal structure, with slight variations. In the largest alone, *a*, the free edges protrude beyond the pearl shell, and the surface rises into mammillæ. The other two, *b*, *c*, have no mammillæ, but show a distinct tendency to produce them, since groups of thick-walled calicles appear as if about to swell up.

The wall formation is very unusual.

a. Zool. Dept. 90. 6. 20. 8 (part)

b. *c*. Zool. Dept. 90. 6. 20. 9.

209. **Porites Ceylon** (22)**13**. (*P. Ceylonica tertiadecima.*) (Pl. XXXI. fig. 4; Pl. XXXV. fig. 23.)

[Ramesvaram sub-fossil Reef, coll. E. Thurston; British Museum.]

Description.—The corallum rises into small nodules with lobed or knobbed surface, and with creeping edges often bending outwards. The lateral knobs tend to have steep sides and rounded tops, but this feature is not strongly marked. The creeping edge is very thin.

The calicles are small, about 0·75 mm., rather ill defined. The wall on the uppermost parts of the stock, where growth is most rapid, consists of a zigzag thread joining tall, erect and rather stout radial flakes with smooth edges and sides. These represent both wall-trabeculæ and exsert septa. Down the sides these septa are less and less exsert till they do not rise above the level of the surface; the appearance of fresh synapticular junctions tends to make the wall reticular, and at the same time the smoothness of the elements is lost, and frosted swellings or granules appear. The septal formula can be made out, but it is rather irregular, and some of the secondaries are very feebly developed. There are five principal pali, a very deep fossa without trace of central tubercle or of columellar tangle, though by focussing downwards one is aware of tissue running round the fossa and forming what, from above, appears to be a ring. The interseptal loculi are large, and their entrances into the deep fossa give the calicles a star-like appearance when seen from above.

The section where growth is rapid appears closely to resemble that characteristic of *Astræopora*. The colour was a rich fawn.

There is one small specimen of this beautiful coral. The growth is very remarkable. The tall septal flakes rising like scales above the level of the surface is as far as I can remember unique in the genus. We may compare it with *P. Great Barrier Reef 5* (Pl. XIV. fig. 5), in

which, however, the tall trabeculæ are rounded and show no traces of being flattened into septa, a specialisation which is if anything still more remarkable.

Underneath the specimen the sections of the supporting base are very puzzling. They appear to be sections of an *Astræopora*, so many concentric shells of lamellæ, about 1 mm. apart and supported by small radial columns,* but in this case without calicle cavities, and hence hardly sections of a true *Astræopora*. Indeed, it seems to me that this appearance might be yielded by a section of the *Porites* colony forming the upper parts of the specimen. If so, the regular concentric arrangement of the horizontal elements is very remarkable. A section of the edge which can be seen certainly shows a tendency in the horizontal elements to form continuous sheets. Another argument in favour of this view is that the section which appears in texture so like that of *Astræopora*, shows by the arrangement of the layers that the surface of the stock to which it belonged was once lobed or humpy, which is very rare in *Astræopora*, but is characteristic of this *Porites*.

a. Zool. Dept. 1904. 10. 17. 56.

210. **Porites Ceylon** $_{(22)}$**14.** (*P. Ceylonica quartadecima.*)

[Ramesvaram sub-fossil reef,† coll. E. Thurston; British Museum.]

Description.—The sub-fossilised corallum was massive, with upper surface raised into two or three large rounded hummocks. The substance has been altered to varying depths. Some internal sections, however, are perfectly preserved. The intra-calicular skeleton seems generally to decay at the surface, while the walls persist and become smooth and solid, as if their elements had been partially melted together.

From the internal skeleton we gather that the calicles were 1 mm. in diameter, the walls were here thin and simple, there reticular but still thin. Their height on the original surface is unknown. The septa seen in the transverse section are thin, straggling, and uniting in the typical manner, with large, open, interseptal loculi. There are no visible thickenings of the septa to indicate the former presence of pali. In the triplet the two laterals bend round to the directive; there is no portion of a ring round the fossa helping to make the typical trident formation of the triplet. There is a short, flattened central tubercle, and the junctions between it and the septal fusions are very scanty, showing that the columellar tangle was very thin and straggling. The trabeculæ are sub-lamellate, and as if streaming without any continuous horizontal elements.

The hollowing out of the calicles on the decayed outer surface gives the specimen a very alveolar appearance, the calicles appearing deep and sharply angular. There is one large specimen which appears to have been nearly complete.

a. Zool. Dept. 1904. 10. 17. 57.

* See Notes on *Astræopora*, Ann. and Mag. Nat. Hist. 6° xvi. (1895) p. 273. Very close imitations of the extraordinary skeletal arrangement of *Astræopora* are frequently found in *Madrepora*.

† For an account of this reef by Mr. Thurston, see Bulletin Madras Government Museum, No. 3 (1895) pp. 91–93.

211. **Porites Ceylon** $_{(22)}$**15.** (*P. Ceylonica quintadecima.*)

[Ramesvaram sub-fossil reef,* coll. E. Thurston; British Museum.]

Description.—The sub-fossilised corallum appears to have been massive. The single specimen is a small flake, 2 cm. thick, showing a worn upper surface and a horizontal section.

The calicles are 1 mm. across. The walls are reticular, the median parts flaky, but the flakes give place to filaments, so that immediately round the calicle the reticulum is a close tangle of threads; this runs as the intra-calicular skeleton across the calicle, greatly obscuring the radial symmetry. The short, thin, bent septa early meet a large reticular columellar tangle, in which again the horizontal flakes like those of the wall appear. The calicles are rendered visible chiefly by the rounded interseptal loculi being arranged in rings, otherwise the horizontal section would have been a close, evenly porous, flaky and filamentous reticulum.

There is one other specimen from Ceylon with flaky walls arranged like this, viz. *P. Ceylon 9* (Pl. XXXI. fig. 1), but the skeletal elements are more delicate and with serrated edges. In this case they are all perfectly smooth, but that might be due to a secondary corrosion of the finer points by the action of water on the dead coral.

a. Zool. Dept. 1904. 10. 17. 58.

212. **Porites Ceylon** $_{(22)}$**16.** (*P. Ceylonica sextadecima.*) (Pl. XXXI. fig. 5.)

[Galle, coll. Dr. Ondaatje; British Museum.]

Syn. "*Porites punctata* Linné" Ridley, Ann. and Mag. Nat. Hist. xi. (1883) p. 258.

Description.—The corallum forms massive blocks, with smooth rounded surface; complete form unknown.

The calicles are small, slightly under 1 mm., round, slightly but sharply sunk. The walls are an open flaky reticulum, with regular round pores. The flakes are confined to the walls, and never invade the calicle as tongue-like septa. These latter are thin, smooth and thread-like seen from above; seen sideways they are laminate but with large interrupting pores. They all join a columellar ring, which is seldom quite complete, and sometimes surrounds an open, deep, circular fossa, or is filled up by a tangle. Round this fossa the interseptal loculi form a ring of large, round, very conspicuous holes. Very faint elevations on the columellar ring and where the septa meet are the only indications of pali, of which no traces whatever can be seen from above.

The section shows a rather close system of trabeculæ, inclined to be lamellate. The horizontal elements are too irregular to be visible as such, being represented by portions of lamellæ often separated by considerable intervals.

* See last footnote.

The coral presents a very striking variation on those forms of the genus which have walls of a flaky reticulum, the septa being smooth and thin. It is not only interesting on that account, but because its surface characters are not unlike those of the coral called by Esper *Madrepora punctata* (Suppl. i. (1797) p. 86, pl. lxx.). That coral was, however, from the Moluccas, so that it is safer to describe this one separately. Esper's name has already been applied too freely to different corals (see under *P. Moluccas 1*, p. 161) some of which are certainly entirely different.

a. Zool. Dept. 83. 3. 24. 2.

213. **Porites Ceylon** (22)**17.** (*P. Ceylonica septimadecima.*)

[Galle, coll. Dr. Ondaatje; British Museum.]

Syn. *Porites echinulata* Ridley, Ann. and Mag. Nat. Hist. xi. (1889) p. 258.

This was a *Porites* recorded by Mr. Ridley from Ceylon and not described, apparently because it so closely resembled the Red Sea form called *P. echinulata* by Dr. Klunzinger (see *P. Red Sea 7*, p. 241). I have not been able to examine the specimen.

214. **Porites Ceylon** (22)**18.** (*P. Ceylonica octavadecima.*) (Pl. XXXI. fig. 6.)

[Galle, coll. Dr. Ondaatje; British Museum.]

Syn. *Porites Gaimardi* Ridley, Ann. and Mag. Nat. Hist. xi. (1883) p. 258.

Description.—The corallum is massive, with slightly convex top, which is everywhere raised into a number of small, rounded waves.

The calicles are shallow, variable in size up to 1·25 mm. and sub-circular on the tops of the waves, small and angular in the narrow valleys. The walls are uniformly low, sharp, membranous ridges, seldom perforated, slightly wavy, with smooth but uneven edges, that is here a little taller, there a little shorter, sometimes rising into points at the angles. The septa begin below the edges of the walls; they are thin, wavy, and with irregular swellings; near the walls they sometimes form a second inner synapticular ring, or themselves fork, especially where an angle in the wall between it and the inner circle of the calicle skeleton has to be filled up. They usually meet a partial or complete columellar ring which is very thin and filamentous. An imperfect ring of paliform rods rises from this circle, but they are not conspicuous, and never reach to the top level of the wall. The triplet is trident-shaped, and the small central tubercle is flattened in the directive plane. The skeletal elements, viz. the

septa and columellar tangle, being very thin, the interspaces—interseptal loculi, etc.—are all large and open.

The section shows a streaming of stout lamellate trabeculæ with large oval pores in vertical series.

There is only one round disc-shaped specimen which has been sawn off a larger mass, leaving no certain trace as to whether the original was globular with flattened top, or thick and cake-like. The lamellate trabeculæ showing at the surface in the membranous walls suggest the former as its growth-form.

For Mr. Ridley's identification of it with Quoy and Gaimard's specimen from Vanikoro, compare description of that coral, p. 82.

a. Zool. Dept. 82. 7. 31. 10.

215. Porites Ceylon (22)19. (*P. Ceylonica nonadecima.*)

[Shore reefs near Galle and Belligam, coll. Ernst Haeckel; Museum Zool. Inst., Jena.]

Syn. "*Synarœa convexa* Verrill" Ortmann, Zool. Jahrb. iv. (Syst.) (1889) p. 500.

Description.—The corallum is regularly hemispherical, consisting of numbers of upright, angular, and coalescing branches. The branches do not fuse so completely as to make the coral a solid mass internally.

The calicles are crowded, small, and shallow. The pali are short, thick, and blunt.

Dr. Ortmann found some of the specimens slightly different from *S. convexa* and more like the *S. solida* of Verrill, in the thickness and length (1·2 cm.) of the free twigs projecting at the surface. At the same time he noted that Verrill's *S. convexa, solida,* and *irregularis* were only variations of the same coral (see *P. Society Islands 3*). None of the Ceylon forms in the National Collection are cœnenchymatous.

216. Porites Ceylon (22)20. (*P. Ceylonica vicesima.*)

[Shore reefs near Galle and Belligam, coll. Ernst Haeckel; Museum Zool. Inst., Jena.]

Syn. "*Porites lutea*" Ortmann, Zool. Jahrb. iv. (Syst.) (1889) p. 501.

Description.—The corallum is massive, convex, and humpy.

The calicles are 1 mm. in diameter and more; the walls are thin; the pali are visible; the columella obscured.

Dr. Ortmann refers also to Dana's figure (Zooph. pl. lv. fig. 3) and Dr. Klunzinger's figure (Die Korallthiere des Rothen Meeres ii. pl. v. fig. 16), but neither of these seem to me to be the same as the coral from Tongatabu, called "*P. lutea*" by Milne-Edwards and Haime; for a description of it see *P. Tonga Islands 1*, p. 34.

217. **Porites Ceylon** $_{(22)}$**21.** (*P. Ceylonica prima et vicesima.*)

[Shore-reefs near Galle and Belligam, coll. Ernst Haeckel; Museum Zool. Inst., Jena.]

Syn. *Porites fragosa* Ortmann, Zool. Jahrb. iv. (Syst.) (1889) p. 501.

Description.—The corallum rises from a broad, humpy base on a constricted stalk, the top of which flattens out, mushroom-like, into a round expanded disc, humpy and with indented contour.

The calicles are 1 mm. across and flat; the walls are thick; the pali visible; but the columella (=central tubercle) obscure.

This is again one of Dr. Ortmann's descriptions. Unfortunately Dana's description of his *P. fragosa* is very incomplete, and there is no evidence that the two are really alike.

218. **Porites Ceylon** $_{(22)}$**22.** (*P. Ceylonica secunda et vicesima.*)

[Shore-reefs near Galle and Belligam, coll. Ernst Haeckel; Museum Zool. Inst., Jena.]

Syn. *Porites cribripora* Ortmann, Zool. Jahrb. iv. (Syst.) (1889) p. 501.

Description.—The corallum is encrusting and humpy.

The calicles are very small, hardly 0·5 mm. in diameter; the walls are blunt, but of variable thicknesses; columella hardly visible.

This is Dr. Ortmann's description, but his identification overlooks the fact that Dana's *Porites cribripora* from Fiji had calicles twice as large, and, as he himself notes, less crowded than is the case in this Ceylon form. We know little about the affinities of corals, and we shall not gain anything by assuming such distant forms to be closely related.

MALDIVES.

219. **Porites Maldives** $_{(3)}$**1.** (*P. Maldivium prima.*) (Pl. XXXI. fig. 7.)

[Maldives; British Museum.]

Description.—The corallum forms rounded irregular knobs, rising from loose fragments of corroded coral and calcareous algæ. The surface is nearly smooth, and the living layer creeps down irregularly and is sometimes 6 cm. deep.

The calicles are 1 mm. in diameter, flush with the surface, and circular. The walls vary in thickness; where thinnest they consist of a delicate, incomplete, membranous ridge slightly raised. This thickens as a very open filamentous reticulum, which extends either right to the top of the wall ridge or stops below it; it may either merely fill in the angles and make the calicles circular, or the whole wall may be thickened. In all the calicles with the thinnest walls

the formation of an inner synapticular wall can be traced. The septa, like the wall ridges, are extremely thin and delicate; fine septal granules rise above the synapticular wall, and thin plate-like pali in complete formula, the triplet being arranged like a trident with a flat central tubercle. The columellar tangle is very conspicuous.

There is no section, and the colour is a greyish brown.

The delicacy and thinness of the skeletal elements is one of the chief features of this coral, at least of all the upper parts of it. Round the lower edges the septa and walls become coarse and granular. The specimen is also remarkable from the fact that there are four young colonies on it of different sizes. They are all totally unlike the delicate calicles above described, but not unlike the thicker, coarser calicles of the lower edges, but this is enough to justify us in regarding them as colonies of this same coral. In the very youngest the calicles are incomplete and irregular, and bear no resemblance whatever to those of the adult colony. One cause of difference may be seen in the fact that the young colony rising very convex while its size is still very small, the calicles necessarily appear to be deep and conical.

a. With four young stocks growing round the base. Zool. Dept. 86. 11. 22. 7.

220. **Porites Maldives** $_{(3)}$**2.** (*P. Maldivium secunda.*) (Pl. XXXI. fig. 3; Pl. XXXIV. fig. 3.)

[Maldives; British Museum.]

Description.—The corallum forms tufts of thin, narrow stems, the tips of which are flabellate and divide into short, blunt lobes or knobs 6–8 mm. thick, and under 1 cm. long; the stems may be either long and erect, or squat and fused together. The living layer extends only 4–5 cm. downwards, even at the outer edges of the stock.*

The calicles are deep conical punctures, even down to the edges of the living colony. At the tips of the branchlets they are very deep, large (sometimes 2 mm.) and angular. The walls have sharp median ridges, porous, ragged, and membranous. These are mostly thickened into a reticulum, which near the creeping edge rises to the top of the wall ridges. The septa slope steeply inwards, and the wall thickening is apparently due to their synapticular thickenings, although there is seldom any regularity or symmetry visible. The fusions of the septa are quite irregular; they slope downwards and lose themselves in a granular tangle in the base of the calicle. There is thus no regular ring of pali nor central tubercle.

The section of a stem shows a loose, open reticulum of stout threads with large meshes, and with obscured, irregular trabeculæ traceable round the periphery. The colour is a rich dark brown.

There are two specimens of this coral. They resemble one another in having essentially the same kind of calicle and the same type of growth-form, only in the one (*a*) the flabellate branches are thin and erect, in the other (*b*) they are very short, freely fused, and with branchlets

* In tuft formations it is usual to find that the living coral extends much further down the outermost stems than it does on any of the inner stems.

shorter and a little thicker. In both, the tips of these branchlets when rounded end in a delicate flaky reticulum, and in *b* this open flaky reticulum is frequently developed also in the angles between two stems or branchlets.

Both specimens show the skeletal elements hollowed out by a burrowing alga. Specimen *a* has a remote resemblance to *P. Mauritius 3*, but close examination shows them to be different in every detail.

a. With erect free branches. Zool. Dept. 86. 11. 22. 12.
b. Branches short and fused into a convex mass. Zool. Dept. 86. 11. 22. 4.

221. **Porites Maldives** (3)**3.** (*P. Maldivium tertia.*) (Pl. XXXI. fig. 9; Pl. XXXIV. fig. 7.)

[Maldives; British Museum.]

Description.—The corallum forms large, unattached lenticular tangles of stems, either fused together or joined by explanate outgrowths. Great numbers of thin, bent, and curving processes radiate very irregularly outwards in all directions, not only upwards and downwards, but also radially round the periphery. These flatten at the tips, and fork. The stock rests on the tips of those which happen to be undermost. As the coral increases in size and weight and ceases to roll, the under portion dies. The living layer is some 7 cm. deep.

The calicles are polygonal, about 1·25 mm., flush with the surface. The walls are slightly raised as a median ridge on the tips, and for varying short distances down the sides of the branchlets. This ridge is a thin, straight or wrinkled, seldom zigzag, granular thread, sometimes, especially in the lower parts of the stock, visibly rising from a layer of flakes. It is, here and there regularly thickened by portions of the synapticular wall. The thin septa are fairly regular, showing at the surface as rings of septal granules and pali, with sometimes wall-granules apart from the ridge as well. The surface is thus a layer of minute granules, in which the calicles can be easily recognised by their arrangement. The pali are frequently in complete formula. The central tubercle is sometimes—that is, when the fossa is deep and open—wanting, at others distinct, and rising from a large tangle which, lower down, almost fills the calicle, for the septa seem to be freely joined by scattered synapticulæ.

The section shows a stout, open, very lamellate, streaming reticulum, which appears at all the tips of the processes, with calicles opening in its surface. Round this is a close layer of stout radial trabeculæ, very pronounced, with rows of small pores between, and only slight development of continuous concentric elements. The colour is a rich chocolate-brown.

This coral is very interesting; its detached yet branching growth (cf. *P. Mauritius 5*), its very pronounced axial streaming reticulum of stout lamellæ, in sharp contrast with the radial trabeculæ, and the number of granules along the lines of the septa—there are sometimes four, including the ridge granule—are the chief features of interest. On the last point, compare the Introduction, p. 15.

Pl. XXXI. fig. 1 shows the calicles of a creeping edge, where the surface granules are less pronounced.

a. Zool. Dept. 86. 11. 22. 13.
b. With three bleached fragments. Zool. Dept. 86. 11. 22. 2.

DIEGO GARCIA.

222. **Porites Diego Garcia** (3)**1.** (*P. Garciana prima.*) (Pl. XXXII. fig. 1.)

[Diego Garcia, coll. G. C. Bourne; British Museum.]

Description.—The corallum forms massive, rounded, convex stocks, with thick, pendent, or encrusting edges, the latter bending outwards or under.

The calicles are 1·25–1·5 mm. across, deep and angular. The walls thin, straight, steep and membranous, irregularly fenestrated, and with slightly but sharply echinulate sides, and jagged, not regularly denticulate, edges. The septa, faintly indicated on the membranous walls by the echinulæ, project as very thin, short, much perforated lamellæ, arranged symmetrically round a large deep central fossa, in which a loose reticular tangle of thin strands can be seen far down. The pali are inconspicuous as thin, erect rods or plates, often only faintly indicated in the complete formula of eight. The interseptal loculi are large and open. There is a thin, flattened columellar tubercle.

Down the sides and just round the edges places may be found where the median membranous wall is not visible, and finely-toothed lamellate septa run continuously over the intervening reticular tissue to join with those of adjacent calicles.

The section shows an open, streaming reticulum, with large oval meshes in which trabeculæ appear sometimes as thin, delicate, glassy filaments, sometimes as lamellæ. The colour is brownish grey.

This coral, of which there is only one specimen, 9 cm. long, 7 cm. broad and 4 cm. deep, is very beautiful. It shows the correlation between the depth of the calicles and the development of the pali described in the Introduction, p. 20.

a. Zool. Dept. 91. 4. 9. 27.

223. **Porites Diego Garcia** (3)**2.** (*P. Garciana secunda.*) (Pl. XXXII. fig. 2.)

[Diego Garcia, coll. G. C. Bourne; British Museum.]

Description.—The corallum forms irregular rounded masses, clinging by close encrustation to corroded masses of coral rock, and falling over, if the latter are loose, in which case the mass bends up again into the vertical.

The calicles are 1 mm. in diameter, shallow, and round. The wall is a low, smooth, thin membrane, on each side of which there is usually a shelf of flat flakes, very jagged and irregular, and frequently with a ring of large perforations corresponding with the interseptal loculi. On these flakes the frosted septal granules arise, sometimes joined to the walls, and

sometimes to the pali. The septa themselves are either thin and short, or horizontally flattened and curving as offshoots of the synapticular shelf. The pali rise to the level of the wall: the five principals as frosted knobs, like the septal granules. The dorsal directive has either no knob, or a very minute one. The fossa seems to be early filled up by flaky tissue, from which a small central tubercle rises, but not to the height of the pali.

Low down on the sides of the stock the median wall sinks, the shelves greatly widen, and the walls are thick and built of stout flakes; the septa become broader, and the granules and pali larger and coarser.

There is no available section, and the colour of the unbleached stock is a light yellowish brown.

There is, again, only one specimen of this beautiful *Porites*. This form of the synapticular shelf is, so far, unique.

a. Zool. Dept. 91. 4. 9. 37.

224. **Porites Diego Garcia** $_{(3)}$**3.** (*P. Garciana tertia.*) (Pl. XXXII. fig. 3; Pl. XXXIV. fig. 4.)

[Diego Garcia, coll. G. C. Bourne; British Museum.]

Description.—The corallum rises as a close cluster of short, thick, often flabellate stems. This gradually expands into a wider and more open arrangement of thinner flabellate branches, which again fork. Before doing so, the branchlets usually taper rather suddenly, and then swell into small knobs which flatten, the compression being in the plane of that of the branches. The successive forkings follow one another every 1·5 cm. of upward growth, so that the fan-like expansion of the branches is rapid and open. The living layer reaches here and there to 8 cm.

The calicles are 1 mm. in diameter, flush with the surface, and sub-circular. The walls show an elegant arrangement of flat flakes, with round perforations and crisp edges; from the surfaces of the flakes thin threads, points and straggling plates arise, and give the surface a velvety appearance. The tips of these surface upgrowths expand and form the next layer of horizontal wall flakes. The septa are not visibly tongues of the wall flakes, but show characters more like the thin plates which rise on the walls, only they tend to swell into rings of septal granules and pali. On the lower parts of the stock these become large and very finely echinulate. Neither of these rings is quite symmetrically round or oval, the directives being nearer the periphery and interrupting the curve. The complete palic formula is frequently present; the triplet, however, is irregular. There is a flattened central tubercle.

The section shows a system of very stout trabeculæ, rather loosely arranged, and with distinct but not very stout horizontal or concentric elements. The colour of the unbleached coral is a warm brown.

The chief point of interest in this coral is the fact that it combines the two characters of branching *Porites* described in the Introduction, p. 21. The horizontal elements are con-

spicuous in the walls of the calicles, but not in the septa, while the trabecular elements become conspicuous in the size of the septal granules and pali. Both elements are conspicuous, without either being developed at the expense of the other.

Similar small, constricted, squarish knobs at the tips of the branches, each consisting mainly of the undifferentiated, flaky, axial reticulum, are found also in *P. Maldives 3.*

a. Zool. Dept. 91. 4. 9. 39.

RODRIGUEZ.

The following from Rodriguez, collected during the Transit of Venus expedition in 1874–75, were arranged by Dr. Brüggemann * under two separate species. In my judgment they show essentially the same type of calicle structure, with *irregularly* reticular walls changing at any moment into quite thin, straight, single threads or membranes, no traces of which are found as median ridges or plates when the wall becomes reticular. The growth-forms also show a similarity reminding us of the Ramesvaram series, here called *P. Ceylon 1–8.* The stocks grow either on the tops of other corals or on the overturned masses of their own previous growths, as if unable to adhere to the inorganic substratum, whatever it was. I have divided them into two heads. The first has very small calicles, and forms a flat cake on the top of a dead Astræid, traces of which can still be seen; while in the second the stock rises like a stalked knob from the side of the mass of its own previous growth.

225. Porites Rodriguez (2)1. (*P. Rodericensis prima.*) (Pl. XXXII. fig. 4.)

[Rodriguez, coll. Transit of Venus Expedition; † British Museum.]

Syn. "*Porites lutea* M.-E. & H." Brüggemann, Phil. Trans. clxviii. (1879) p. 577.

Description.—The corallum forms large round cakes, flattened on the top, and very smooth. The edges are closely encrusting, and here and there bending under.

The calicles are small, under 1 mm., sub-circular, shallow, yet rather sharply sunk between thick walls. The walls are a rather close irregular reticulum, without trace of median ridge or radial symmetry; the interseptal loculi run as rough notches into the wall. The septa project only deep down, and are thus obscure, but a small conspicuous ring of five pali rises nearly to the height of the wall (formula F, fig. 3, Introduction, p. 19). The minute deep pin-hole fossa is visible to the naked eye.

There is no available section. The colour is a light grey.

* Phil. Trans., vol. clxviii. (1879) p. 577.

† The name "Gulliver" on the label refers to one of the naturalists of the expedition.

The single specimen at one time enveloped the top of an Astræid coral. The small size of the calicles differentiates it from the next form. Both are alike in having reticular walls, and conspicuous rings of pali; and, again, neither seem to have originally adhered to any firm base. This one grew upon a coral, and the next upon fragments apparently of organic origin, which allow the coral to topple over when it gets at all heavy.

Brüggemann's identification of it with *Porites lutea* of Milne-Edwards, which included Quoy and Gaimard's coral from Tonga, and others from the Red Sea, was not based upon any close study of Milne-Edwards' specimens (see above, p. 34, and below, p. 244).

a. Zool. Dept. 76. 5. 5. 45.

226. **Porites Rodriguez** (2)**2**. (*P. Rodericensis secunda.*) (Pl. XXXII. fig. 5; Pl. XXXV. fig. 28.)

[Rodriguez, coll. Transit of Venus Expedition; British Museum.]

Syn. *Porites arenosa* * Brüggemann, Phil. Trans., clxviii. (1879) p. 577.

Description.—The corallum grew upon a loose organic fragment, and as it increased in size it rolled over. From its side a new stock rises upwards and swells into a knob, with a short, thick stalk. The stock is thus roughly dumb-bell shaped, the smaller distorted and corroded knob forming the base, from which the larger and more symmetrical recent colony rises. The edge is closely adherent, and bends under.

The calicles are conspicuous, 1 mm. in diameter, varying rapidly from angular to subcircular. The walls vary suddenly and apparently arbitrarily from being thin, straight and membranous, to an irregular reticulum; the walls of adjacent calicles or even parts of one and the same calicle may vary; and, when reticular, there are no traces in the coarse open meshwork of a median ridge corresponding with the membranous walls elsewhere. The septa are thin and membranous, sometimes smooth, at others with a few echinulations, without septal granules, but with a conspicuous oval ring of plate-like pali in the complete formula. The flattened columellar tubercle forms a conspicuous line with the directives, while deeper down there is a compact round columellar tangle very conspicuous in cleaned specimens, because of the ring of large, round, interseptal loculi.

There are no available sections, and the colour seems to have been a warm buff.

There are two specimens, exactly similar in growth-form.

In the larger specimen (*a*) the calicles are larger, and the skeletal elements are slightly thicker and echinulate; in the smaller specimen (*b*) the skeletal elements are very thin and delicate.

a, *b*. Zool. Dept. 76. 5. 5. 44.

* On the label Dr. Brüggemann wrote *Porites arenacea* Lamarck; Esper wrote "*arenosa*."

MAURITIUS.

227. **Porites Mauritius** (5)**1**. (*P. Mauritiensis prima.*) (Pl. XXXII. fig. 6.)

[Mauritius; British Museum.]

Description.—The corallum forms a small, thin, slightly wavy or crumpled disc, uniformly about 2 mm. thick, and attached by its centre. The sharp edges are 1 mm. thick, supported by a thick, chalky epitheca, and expand horizontally and freely.

The calicles are small, under 1 mm. across, ill-defined, with obscured radial symmetry. The walls are thick, slightly raised and rounded, apparently consisting of large coarse granules distinct and scattered. There is an irregular, incomplete ring of septal granules, similar to the wall granules, and often confused with them and with the irregular pali. These last are conspicuous to the naked eye, but excepting the four principals, are very irregular under the pocket lens. The fossa is small and mostly deep, with an occasional ill-defined central tubercle.

The section shows a fairly regular reticulum with large round pores, in which the trabeculæ are only slightly more conspicuous than the horizontal elements. The colour of the unbleached corallum is nearly black.

This *Porites* is so thin that when held up to the light the bleached parts are translucent. The single specimen is 5–6 cm. in diameter, and is associated with an explanate *Montipora* not unlike that called in Vol. III. p. 80, "*M. bilaminata.*"

a. Zool. Dept. 88. 10. 25. 22.

228. **Porites Mauritius** (5)**2**. (*P. Mauritiensis secunda.*)

[Mauritius; British Museum.]

Description.—The corallum is a fragment of a thick, massive block of unknown shape.

The calicles are polygonal, the largest about 1·2 mm., and as shallow pits. The walls are very sharply ridged; they may be simple and thin or else reticular, but in the latter case the ridge persists, and the reticulum is added in the regular manner by the formation of inner synapticular walls; the synapticulæ are often so large that the inner wall is little more than a smooth, flat shelf running round the calicle. The septa run from the wall ridge over the shelf. They are thin and finely frosted or echinulate, and frequently unite with a large oval columellar ring at different depths below the surface. The pali in full formula are very inconspicuous as a large loose scattered ring. There is usually a flattened central tubercle in the large oval fossa; a large conspicuous columellar tangle can be seen.

The section shows a regular trabecular arrangement, with large, numerous and irregular pores; continuous horizontal elements can nowhere be seen. The colour is a rich buff, and penetrates 3·5 mm. below the surface in the section.

The specimen appears as if the stock to which it at one time belonged had been greatly distorted by worm-tubes. The thick section fractured along the line of the trabeculæ shows the latter expanding like a wheatsheaf.

The specimen had been labelled "*Porites arenacea* Lamarck," by Dr. Brüggemann.

a. Zool. Dept. 78. 6. 6. 5.

229. **Porites Mauritius** $_{(5)}$**3**. (*P. Mauritiensis tertia.*) (Pl. XXXII. fig. 7; Pl. XXXIV. fig. 5.)

[Mauritius; British Museum.]

Description.—The corallum rises from a smooth, explanate base with creeping edges into smooth, slender stems, which expand into clusters of four or five branchlets each. Fresh stocks develop with creeping edges, which overrun the dead tips of previous growths. The branchlets are all small, rounded or angular, about 1 cm. long, and from 1 cm. to 5 mm. thick, according as they are swelling prior to dividing or not.

The calicles are small, 1 mm. in diameter, deep and everywhere conspicuous, and with irregular outline. The walls show remarkable variations on the branchlets; they are very thin, ragged and incomplete. These gradually thicken to a flat-topped flaky reticulum (Pl. XXXII. fig. 7) with scattered round meshes. The thin, sharp wall persists for a short way down the stems as a median granular ridge upon the reticulum; low down on the stems the walls may be nearly 1·5 mm. across. The septa are very irregularly developed; the primaries, as short blunt knobs from the edge of the wall flakes, alone meet the central tangle, the secondaries being frequently rudimentary. Six large, round, open, interseptal loculi are very conspicuous. The pali are inconspicuous as short rods or knobs on the primaries. Where the walls are thick the calicles appear as deep, irregularly stellate punctures on the smooth surface.

The section shows an open fragile network, with somewhat indistinct radial trabeculæ.

There is one large bleached stock. Its peculiar feature is the irregular calicular skeleton, with the rudimentary secondaries.

a. Zool. Dept. 83. 7. 27. 12.

230. **Porites Mauritius** $_{(5)}$**4**. (*P. Mauritiensis quarta.*) (Pl. XXXII. fig. 8; Pl. XXXIV. fig. 2.)

[Mauritius; British Museum.]

Description.—The corallum forms immense confused clusters of erect, somewhat irregular separate stems, each about 7 cm. high, and showing from 3–4 distinct and smooth swellings, diminishing in size; the uppermost, which may flatten and be less than 1 cm. thick, often divides. The stems rise from a closely encrusting basal layer.

The calicles are small but distinct, under 1 mm., very uniform. The walls are thin, straight rows of granules near the tops, but thicken lower down into a reticulum, often without median ridge. The septa are thin, short, and descend symmetrically down the vertical walls, uniting in the principal pairs. The interseptal loculi form a neat ring of small deep holes round the extreme periphery of the calicle. The pali are not conspicuous, all the granules being uniformly small and ill-defined. The complete formula may be often seen. The fossa is deep, and the base filled by a large columellar tangle. The tubercle is often absent, but is sometimes large and flattened.

There is one large bleached specimen towering 35 cm. high. The earlier stock seems to have rolled over, and from innumerable points new nodulated or moniliform stems have sprung. Stems formed out of strings of swellings are known in *Porites* (see *P. Great Barrier Reef 3*, Pl. XIX. fig. 1, and *P. North Australia 6*, Pl. XXIV. fig. 2). The septa and pali rise high in the calicles, and they look shallow, but the columellar tangle is deep down, and the ring of interseptal loculi show the calicle under the pocket-lens as deep and cylindrical. This cylindrical form of the calicle is one of the features of the coral.

a. Zool. Dept. 83. 7. 27. 11.

231. **Porites Mauritius** (5)**5**. (*P. Mauritiensis quinta.*) (Pl. XXXII. fig. 9; Pl. XXXIV. fig. 1.)

[Mauritius; British Museum.]

Description.—The corallum is an unattached cluster of radiating processes with slightly swollen, rounded, or hammer-headed tips. When too large and heavy to roll about, the lower surface dies, and the upper living layer sends down creeping edges over the dead portion.

The calicles are very variable, according to the irregularities of the surface. On any smooth part they may be large, 1·5 mm., polygonal, open, conspicuous, and varying in depth. Over most of the surface small groups of deep funnel-shaped calicles rise up as the starting point of new outgrowths. The walls are very irregular, mostly thin, open, fenestrated, but in the angles and elsewhere thickened as a fine filamentous reticulum. Such a reticulum is also formed at the tips of the processes, both of those growing up freely and of those on which the specimen rested. Young calicles open in the angles. The septa are thin, symmetrical, appearing well below the level of the top of the wall, and with septal granules well developed. The pali are small, not much bigger than the septal granules, but taller; present in complete formula B (fig. 3, p. 19). The fossa is large, round, shallow, and not very distinct. The tubercle is thin and flattened, and on a level with the pali. The interseptal loculi have no sharp outlines, owing to the fine frosting of the septa.

The section shows a confused open reticulum with very obscure radial trabeculæ and thick axial meshwork. The colour is brown.

There are two specimens, showing two interesting stages of growth. One (*a*) is quite young, small and straggling, of a light brown colour and with the calicles very uniform, polygonal, shallow funnel-shaped, with frequently wall-, as well as septal-granules, and with

only slight differentiation of pali; and (*b*) a large lens-shaped mass, dying on one side, proliferating on the other (see Pl. XXXIV. fig. 1), with the calicles usually deeper and less uniform. On the smoother surfaces the calicles in the two forms closely approximate. For other free branching stocks, see Table III.

a. Zool. Dept. 98. 4. 21. 2.
b. Zool. Dept. 83. 7. 27. 18.
c. Fragments of *b*. Zool. Dept. 83. 7. 27. 13.

In addition to the above, Dr. Ortmann* records several fragments of *Porites* from Mauritius in the Strasburg Museum. Two of these he proposed to identify specifically: one with the Red Sea form called *Porites solida* by Klunzinger (see p. 236); the other, being a cœnenchymatous form, with *Synaræa* (= *Porites*) *danæ* M.-E. & H., which was from the Fiji Islands (see p. 51.)

SEYCHELLES.

232. **Porites Seychelles** (1)**1.** (*P. Seychellensis prima.*)

[Seychelles, coll. M. L. Rousseau; Paris Museum.]

Description.—The corallum forks into separate clusters of deeply incised, flabellate, or cockscomb like ridges, 4–6 cm. high, and with curving edges which tend to rise up at the ends of the ridges into points. The living layer is about 6 cm. deep, and its lower edges may bend freely outwards from the dead previous growth.

The calicles are deep and funnel-shaped, 1·5 mm. across. The walls have sharp median ridges, sometimes as continuous threads, sometimes as so many interrupted ends of reticular threads. Seen from above the walls appear thick, owing to the compact ring of septa sloping away on each side of them. The septa are short, very thick and symmetrical, hardly, however, fusing. In the base of the funnel a deep round fossa sinks suddenly down, with no traces of pali on the ends of the sloping septa.

This coral is No. 197 in the Paris Museum, and is labelled *P. nodifera*, but it is very different indeed from the Red Sea coral to which Dr. Klunzinger gives that name (see *P. Red Sea 3*, p. 239). While I have been unable to include all the Paris Museum *Porites* on which I possess illustrated notes, I think that the growth-form and the character of the calicles in this coral are sufficiently interesting to justify minute description in this Catalogue.

In 'Les Coralliaires,' iii. (1860) p. 180, Milne-Edwards records a *Porites* from the Seychelles which he referred to the "species" *arenosa*. But on the difficulties of discovering what the actual specimens referred to were, see below on the Red Sea group, p. 245.

* Zool. Jahrb. (Syst.) iii. (1888) pp. 157, 158.

AMIRANTES AND PROVIDENCE ISLAND.

233. **Porites Amirantes** $_{(3)}$**1.** (*P. Amirantium prima.*) (Pl. XXXIII. fig. 1.)

[Darros Island, 22 fathoms, coll. H.M.S. 'Alert'; British Museum.]

Description.—The corallum is minute, round and explanate, very thin, about 1 mm. and 0·5 mm. round the edges, which tend to curl under.

The calicles are quite superficial, far apart, with no distinct outlines, but apparently about 0·5 mm. in diameter; they are visible only as scattered stars, each consisting of two or three straggling radial slits, small, yet deep and conspicuous. The walls which constitute the smooth cœnenchyma, in which the stars are sharply punctured, are frequently 1 mm. across, and consist of a very close angularly filamentous or slightly flaky reticulum, the bent angular threads being all beset with the finest echinulæ, only visible under a pocket-lens. The septa are straggling continuations of these rough threads; they fuse in the typical formula. The triplet and the fused pairs show only faint traces of the enclosed interseptal loculi, while those between the fused pairs which open into the fossa are very pronounced. There are no raised paliform points where the septa meet and fuse. The fossa is nowhere rounded, and there is no columellar tubercle.

The section is an open round-meshed reticulum, in which trabeculæ and horizontal elements are traceable only in the fact that the bulk of the threads run vertically and horizontally. The colour is a pale buff.

For other minute encrusting or explanate *Porites*, see Table III. The surface is perfectly smooth, and the calicles so far apart that it has hardly the aspect of a *Porites*. The septal formula, however, makes this point clear.

a. Zool. Dept. 1904. 10. 17. 59.

234. **Porites Amirantes** $_{(3)}$**2.** (*P. Amirantium secunda.*) (Pl. XXXIII. fig. 2.)

[African Island, 10 fathoms, sand and coral, coll. H.M.S. 'Alert'; British Museum.]

Description.—The corallum is branching. From a short central stem, some 1·5–2 cm. in diameter, a few short, thick, irregularly nodulated branches diverge at wide angles (60°). These fork or put out at almost any angle small curving branchlets which sometimes taper, sometimes fork. The living layer is some 6–7 cm. deep, with a thin creeping edge sometimes free and bending outwards.

The calicles are deep, conical, angular, and irregular in size, up to 1·5 mm. The walls have everywhere a sharp, thin, frosted ridge. The sides of the deep conical depressions on each side of this ridge are thickly beset with short, stout, often knobbed septa, apparently

without radial symmetry, and like so many smooth round grains of different sizes adhering to the sloping walls. Fusions of septa can here and there be traced, and jagged irregular interseptal loculi. Pali are only occasionally hinted at.

The section is an open loose reticulum, in which the concentric elements, though irregular, are more pronounced than the trabecular. The colour of the unbleached stock is a warm brown.

This coral is as remarkable as the last. There is certainly no other *Porites* with such a strange irregular arrangement of septa.

a.	Zool. Dept. 82. 10. 17. 160.
b. A detached branch, but not of *a*.	Zool. Dept. 82. 10. 17. 157.

The four following corals form together a remarkable group. They live on sand, and are all branched; each consists of a central body, from which branches radiate; when the branches are long, it may be dead or merely covered with stray patches of the living colony, which are then for the most part confined to the processes. The stocks rest on the tips of the branches. Three of these corals look alike, having the same buff colour; one is of a dull grey. Two are from the Marie Louise Island, and two from Providence Island.

The grey specimen from Providence Island can easily be seen to be distinct from the other three; but it is difficult to resist the temptation to describe them all under one heading, as was done with the collection of Montipores * from these localities, which showed the same method of growth—in adaptation doubtless to the nature of the sea bottom. But the closer these *Porites* are studied the more clear does it become that they are different both in important details of growth-form and in structure of calicle.

And here we may ask why it should be necessary to assume that they must be of the same species, simply because at first sight they look alike and all live within a circumscribed area. The probability seems to me to be all the other way. Their resemblance may be due to the similarity of the environment. The fact that the Montipores above referred to are difficult to distinguish from these *Porites* shows how powerful the influence of the environment may be in impressing converging characters upon members even of different genera (cf. *P. China Sea 4*, p. 168). The similarity therefore of members of the same genus might be expected, and it is the differences we find in them which are of importance. I feel, therefore, that it is safer to describe the forms separately.

235. Porites Amirantes (3)3. (*P. Amirantium tertia.*)

(Pl. XXXIII. fig. 3; Pl. XXXV. fig. 26.)

[Marie Louise Island, 17 fathoms, sand and coral, coll. H.M.S. 'Alert'; British Museum.]

Two specimens.

Description of specimen *a*.—The corallum is free; it consists of a central elongated body, from which constricted knobs arise, and from the tips of these again other knobs, so that the

* See Vol. III. p. 37.

short processes tend to be moniliform. There is a tendency to develop a smooth epithecal pellicle at the edges, where the colony is dying away.

The calicles are from 1 to 1·2 mm. in diameter, conspicuous on the more recent knobs, where the intra-calicular skeleton is thin, and the calicles appear as dark stains; nearer the central body they become more and more difficult to distinguish on the perfectly smooth, velvety surface. The walls are thick, with only occasional signs (namely, near the tips of the knobs) of any median ridge; they seem nearly solid, and appear to be composed of crystalline granules, the details of which are difficult to unravel. the surface being sprinkled with smaller and more delicate granules. In the uppermost calicles the intra-calicular skeleton shows this same delicate character, only the walls appear solid just beneath the surface; but lower down the whole seems to become solid, with the finer granules giving a velvety surface. The radial symmetry can be traced both in the young calicles opening in the straggling, angular reticulum on the tops of the knobs, and in the more inconspicuous calicles; but it is greatly obscured. There are no pali and no fossa visible to the naked eye.

The section shows a radial arrangement of short trabeculæ, nodulated and stout, and ending in fine jagged points at the surface. The pores are rounded, and largest near the periphery. The colour is bright buff.

The characters of the skeleton of this specimen (*a*) are very difficult to define. The granules are like minute jagged crystals of gum-arabic, and their translucency makes it very difficult to see them. Essentially the same character is found in both specimen *b* and in *P. Providence Islands 1*, but the details of structure are here somewhat more crisp and pronounced.

This specimen seems to have come to anchor, for one-half of it was dead when it was found, and had secreted a film which allowed the surface granules to show through. The lower half may, indeed, have been buried in the sand.

a. Zool. Dept. 82. 10. 17. 207.

Description of specimen *b*.—The corallum is free, branching, and consists of a central body, from which long, very irregular, bent, angular and nodulated stems, covered with knobs and small mammillate processes, radiate in all directions. The living colony is largely confined to the processes.

The calicles are from 1–1·2 mm. in diameter, shallow, but as distinct, concave depressions. The walls everywhere rise as thin, sharp, median ridges, seen sideways, of scattered crystalline granules; these granules are the fine glassy tips of trabeculæ. There is everywhere a tendency for the wall to be thickened regularly by an inner synapticular wall, which, owing to the frosted crystalline character of the skeleton, easily becomes irregular and solid-looking. The septa are symmetrical and end in a low ring of pali, which can be seen with the naked eye surrounding a very minute fossa. The pali are small, very frosted, and generally in the complete formula.

The section and the colour of the coral are similar to those of *a*.

Putting aside the difference in growth-form and in the calicle, the facts (1) that the colour, (2) the texture of the section, (3) the crystalline, gum-arabic aspect of the skeletal elements are the same in both, and that here and there knobs occur in *b* not unlike the knobs which occasion the moniliform branching of *a*, lead me to believe that these specimens, coming as they do from the same locality, must be regarded as specifically identical, at least until we know more of the environment as a determining factor.

b. Zool. Dept. 82. 10. 17. 213.

236. **Porites Providence Island (2)1.** (*P. Prudentis prima.*) (Pl. XXXIII. fig. 4.)

[Providence Island, 19 fathoms, sand and coral, coll. H.M.S. 'Alert'; British Museum.]

Description.—The corallum is free, with short, thick body, from which blunt, truncated processes of varying thicknesses project irregularly about 2 cm. long. The whole is covered by the living colony.

The calicles are about 1·2 mm. in diameter, only slightly pitted. The walls everywhere tend to be thick and reticular, with, however, a median row of frosted, jagged tips of trabeculæ, here faint, there pronounced. The reticulum is open, the pores being smooth and round. The septa are thick, very frosted, or echinulate and symmetrical. There are no pali, and the fossa is very inconspicuous. The interseptal loculi are open, and make the calicles conspicuous.

The colour is a pale buff. There is no section.

This coral may quite well be specifically identical with the two last described from the Amirantes. The habit of living, detached upon a sandy bottom, is the same in all. The chief difference seems to be in the character of the skeletal elements, which are here loose, open and crisp, whereas, in the Amirantes form, they are more granular and obscure. The differences in the shapes of the bodies and processes may be due to slight differences in their local environments (cf. *P. Amirantes 3*).

a. Zool. Dept. 82. 10. 17. 102.

237. **Porites Providence Island (2)2.** (*P. Prudentis secunda.*)
(Pl. XXXIII. fig. 5; Pl. XXXV. fig. 12.)

[Providence Island, 19 fathoms, coral and sand, coll. H.M.S. 'Alert'; British Museum.]

Description.—The corallum was apparently free, like the last. The central body has only encrusting patches of living coral upon it, small knobs and straggling fusing and sub-moniliform branches spring from it, the tips of which are undifferentiated reticulum. The branches may be 5 cm. long and 1·5 cm. thick.

The calicles are symmetrically polygonal, shallow and funnel-shaped, and separated by the low raised ridges between the conical depressions; from ridge to ridge they may be 2 mm. in diameter. The walls are composed of stout, flat flakes, arranged as a network with pores. The septa are long, wedge-shaped tongues of thin flakes with their edges highly echinulate,

while the edges of the wall flakes are smooth. They are usually broken up into granules, which diminish in size towards the centre, and together form symmetrical radial and concentric arrangements. The septa fuse in the typical manner, but without the formation of pali. The interseptal loculi are narrow, but frequently run right up between the mural flakes. The fossa is shallow and ill-defined, and further obscured by a flattened central tubercle highly echinulate like the septa.

The section is close and rather solid. The trabecular elements round the flaky axial reticulum are irregular, sometimes obscured, at others very stout, closely packed, and with obscure concentric elements, at others again the concentric elements are pronounced.

The colour of the unbleached stock is a cold grey.

This coral, exemplified by only one specimen, is almost unique in the genus on account of the beauty of the pattern of its large calicles. The long, wedge-shaped highly frosted or echinulate septa filling up the aperture of the calicle, and broken into two systems of granules, radial and concentric, the tips of the septa diminishing to a vanishing point without formations of conspicuous pali, are especially worth noting.

The stock appears to have been free, for it not only occurs on the same sand and coral bottom as the last coral, but has irregular processes growing out in all directions, on some of which it probably rested. The only visible fracture does not suggest that of a stalk of attachment strong enough to have carried the stock.

a. Zool. Dept. 82. 10. 17. 195.

MADAGASCAR.

238. Porites Madagascar (1)1. (*P. Hannonis prima.*)

[Nossibé; Hamburg Museum.]

Syn. *Porites profundus* Rehberg, Abh. Naturw. Verein Hamb. xii. (1892) p. 48, pl. iii. figs. 4, 5, 6.

Description.—The Corallum forms erect palmate stocks, fused below, and with only a few free, conical, sometimes forking tips. In a stock 10 cm. high, the branches were not more than 1·5 cm. thick.

The calicles are large (sometimes 2·5 mm.), very deep, never superficial, with thin, almost trabecular walls, with sharp, polygonal edges in the upper part of the stock. From these edges the fossa descends steeply, septa only appearing deep down. These are not always uniform, being broader round the periphery, everywhere covered with granules and sometimes with small eminences. The pali are very indistinct, recognisable as a ring in the upper better developed calicles; the columellar tubercle, on the other hand, is thin and clearly visible. In section the texture is loose and open, and dried organic matter appears green.

This is the description of a *Porites* from Nossibé, Madagascar, the growth-form of which is compared with that of *P. mucronata* and *P. palmata*, but which differs from all known species of *Porites* in the great depth of the calicles.

From the figures we gather that at the tips of branches the walls are thin and membranous, but that they gradually become flaky or reticular. The twelve very echinulate septa slope away round the fossa as a series of diminishing granules, and without fusing into pairs. No pali are shown in the drawing of an enlarged calicle. Cf. the calicles of *P. Providence Island 2* (Pl. XXXIII. fig. 5.)

There are many *Porites* in the National Collection with deep calicles, but none with calicles so large as 2·5 mm.

Here I should note that the coral figured by Esper as *Madrepora conglomerata* (Suppl. i. pl. lix.) is a branching Poritid with deep conical calicles, and came from Madagascar. It has hitherto always been regarded as a *Porites* (the *P. conferta* of Dana). But as it had fifteen septa, it should have been placed in the genus *Goniopora* in Vol. IV. (See Part. II. of this Volume.)

Esper's variety of his *M. conglomerata* (Suppl. i. pl. lixA), which is a massive glomerate form, came out of an old collection without locality. It is now quite impossible to identify it.

DAR-ES-SALAAM AND ZANZIBAR.

239. Porites Zanzibar (2)1. (*P Zanzibarensis prima.*)

[Zanzibar, coll. Dr. Stuhlmann; Hamburg Museum.]

Syn. "*Porites conglomerata* Esper" Rehberg, Abh. Naturw. Verein Hamb. xii. (1892) p. 47.

This is merely a record of a *Porites* said to have a branching growth-form resembling that shown in Esper's figure (Suppl. p. 74, pl. lix), which represented a *Goniopora*, and was from Madagascar.

There is no record as to the character of the calicles.

240. Porites Zanzibar (2)2. (*P. Zanzibarensis secunda.*)

[Zanzibar, coll. Dr. Stuhlmann; Hamburg Museum.]

Syn. "*Porites solidus*" Rehberg, Abh. Naturw. Verein Hamb. xii. (1892) p. 48.

Dr. Rehberg records, though without description, large specimens of a *Porites* which he believes to be of the same species as those found by Dr. Klunzinger in the Red Sea and called by him *P. solida*. (See below, *P. Red Sea 1*, p. 236.)

241. Porites Dar-es-Salaam (1)1. (*P. Africana orientalis prima.*)

[Ras Rangoni, coll. Dr. Ortmann ; ? Museum.]

Syn. *Porites reticulum* Ortmann, Zool. Jahrb. vi. (Syst.) (1892) p. 654.

Description.—The corallum, growing up among the "Sea-grass," branches almost from the ground, to which it is very lightly attached. The branches are 8 cm. long, very irregular in shape, knobbed and lobed, from 1 to 2 cm. thick, often fusing, especially near their tips, which then appear flattened. The ultimate branchlets are short, knobbed, and rounded, or else bluntly pointed.

The calicles are quite superficial below and nowhere deepened, about 1 mm. in diameter. The walls on the tops of the stems rise as a network of thin lines above the level of all the rest of the surface. The septal edges are broken up into teeth, of which the pali form the innermost ring, but without being raised above the level of the rest and of the columellar tubercle.

This coral obviously owes its growth-form to the grass, one influence of which is to hold the sand still and allow corals to settle. Coral growth is impossible where the waves keep the sand in motion.

Other *Porites* recorded from the Dar-es-Salaam Reefs are—

1. Several specimens, some hemispherical and attached to the rocks of the Chokir Bank, and other small free nodules found among the grass of Ras Rangoni. All these the author proposes to identify with *Porites lutea* of Milne-Edwards, which is one of the well-worn names freely attached to *Porites* from all parts of the world, whereas it belongs solely to the form from Tongatabu and its characters are described on p. 34. (Cf. also p. 244, where will be seen some account of the origin of the confusion.)

2. Several lobed (? branched) masses found loose in the sea-grass, which Dr. Ortmann believed to be specifically identical with the *P. Red Sea 3*, called by Dr. Klunzinger "*nodifera.*"

3. A specimen said to resemble the Red Sea form No. 1 (*Porites solida* of Forskål), which has been identified by Dr. Klunzinger, because it is the *Porites* which supplies much of the building stone on the shores of the Red Sea. Dr. Klunzinger has given a full description with photographs. Dr. Ortmann's specimen was found on the rocks of Chokir Bank.

4. Specimens which Dr. Ortmann claims to be older, and more developed colonies of the Red Sea coral (No. 7), described by Dr. Klunzinger as "*Porites echinulata.*" In two of the forms a few cylindrical columns arise 1 cm. thick and 4 cm. high. These may repeatedly divide, and the calicles on them have sharper and thinner walls. They were found on the Upanga Reef.

The difficulty of identifying *Porites* even when one has the forms in one's hand is so great, that it would have been safer if these forms had all been properly described by the author and not simply referred to certain supposed species.

CAPE OF GOOD HOPE.

242. **Porites Cape of Good Hope (1)1.** (*P. Capensis prima.*)

[Cape of Good Hope, colls. Krauss and Bowerbank; British Museum.]

Description.—The corallum forms solid masses without any symmetry of growth, sometimes as smooth flat cakes irregularly folded and distorted, with sand and quartz grains embedded; fresh surfaces seem to creep over parts which have been killed by the sand.

The calicles are from 1–1·25 mm. in diameter, angular or sub-circular, densely crowded and deepened; the walls are sharp-edged, frequently zigzag, not seldom incomplete; the skeletal elements being thick, usually smooth, threads. The intra-calicular, or septal, skeleton is only completed some way down, and appears irregular. Traces of stout pali can be seen and of the complete septal formula, but the surface of the specimen seems to have suffered somewhat. The section, however, shows it to consist of long, stout, wavy and continuous trabeculæ, quite far apart and joined by comparatively thin horizontal bars.

This coral is interesting because of its locality and habit of life. I am not aware of any reefs at the Cape of Good Hope, and the specimens seem to live in the presence of vast numbers of large angular quartz-grains and pebbles.

a. Zool. Dept. 49. 10. 5. 11.
b. Zool. Dept. 40. 9. 30. 22.

Group V.—INDIA AND PERSIA.

INDIA.

Several "Porites" were described from Sind by Martin Duncan, but, as far as I can make out, only one of them really belongs to the genus, namely the last in the following list:

Porites superposita is a *Goniopora*. (See Vol. IV. p. 93.)
Porites pellegrini. (See remarks below.)
Porites Indica is a *Goniopora*. (See Vol. IV. p. 94.)
Porites gajensis ? a *Goniopora*.
Porites incrustans. (See below.)

Porites pellegrini Duncan:—In Vol. IV. p. 108, I expressed the opinion that the Sind coral called *Porites pellegrini* Duncan* (non D'Achiardi) was a true *Porites*. The *Porites pellegrini* of D'Achiardi and Reuss were certainly *Gonioporæ*. I now doubt very much

* Sind fossil corals, Mem. Geol. Surv. India (1880) p 67; pl. v. figs. 14, 15.

whether Duncan's coral is even a Poritid at all, and for the following reasons. The figures show no *Porites* character, except the number of the septa. But there is nothing in the character of the septa or of the walls to suggest a Poritid. The typical fusions of the septa of *Porites* are not seen, although the calicles are not deep, in which case these fusions might perhaps have been unrecognisable. Further, their character is not suggestive of the septa of *Porites*. Rows of granules, rounded by secondary weathering, are possible, but I have never seen a *Porites* with more than four granules on each septum, except in abnormal, rather distorted calicles, when one or two septa may be lengthened. These four are the wall-ridge or intervening granules, the wall-granules proper, the septal granules, and the pali (cf. p. 15). Now the septa in Duncan's figure have mostly five to six granules, and thus do not conform at least with typical recent forms.

D'Achiardi's coral, with which Duncan identified this Sind specimen, was, as stated, a *Goniopora* with sixteen to twenty-four septa.

With regard to Duncan's *Porites gajensis* (l. c. p. 99), this is apparently a true Poritid, but if so, it is one of those doubtful cases which hover between *Porites* and *Goniopora*. Duncan only figures one calicle (l. c. pl. xxii. figs. 6, 7) with about twelve septa. If we may argue from this single figure, we note that the septa show no trace of the septal formula of *Porites*, but the style of the forking is what might well be seen in a *Goniopora* in which the septa are secondarily aborting. I am therefore now inclined to think that Duncan's *Porites gajensis* should be added to the list of *Gonioporæ*. (See Part II. of this Volume.)

The following form seems to be a true *Porites*.

243. Porites Sind (D)1. (*P. Sindica prima.*)

[Kurrachee (Tertiary); British Museum.]

Syn. *Porites incrustans* Duncan, Ann. and Mag. Nat. Hist. xiii. (1864) p. 305.

Description.—The fossilised corallum is massive and glomerate, but showing in section concentric growth-periods about 1·3 cm. thick.

The calicles varied greatly in size, the average being under 1·5 mm. They pitted the free surface. The walls were a stout reticulum, the septa were wavy, but apparently showed the typical formula.

Little more can be gathered as to the details of structure of this worn specimen. There can be little doubt that it is a true *Porites*, but on what evidence Duncan described it as of the same species as the *Porites* found in the European Miocene of Turin, Bordeaux, Dax, Carry, Vienna, Hungary and in the San Domingan shales, and all called by their discoverers by this same name, it is very difficult to see. The name has clearly been a snare.

In addition to the original specimen referred to by Duncan, there is also in the National Collection a polished piece of a large pebble showing the remains of calicles of the same general size and with the same stoutness of the reticular walls. It is apparently from the same locality.

a. Duncan's original specimen. Geol. Dept. R. 6385.
b. Polished pebble. Geol. Dept. R. 3457.

PERSIA.

There is a series of thirteen specimens from the Persian Gulf. They seem to have all grown upon a muddy and pebbly bottom. Some grew on clusters of pebbles or on angular blocks to a good size; others are seen to be growing on previous growths, which perhaps started on small pebbles, and, rolling over, supplied a base for new and larger stocks (cf. *P. Ceylon 1–8*).

The normal growth, when firmly established and free from sediment, seems to have been to rise as solid fan-shaped ridges from a thick encrusting base. But these ridges appear to be broken up by deposits of sediment, and the stocks rise as irregular nodulated columns, swelling at the tips. Stocks so affected are full of interstices, and are usually much altered by the action of boring organisms. These changes in the conditions of growth lead to variations in the calicles.

The best systematic treatment which I have been able to arrive at after several attempts is embodied in the following paragraphs.

244. Porites Persia $_{(3)}$**1.** (*P. Persica prima.*) (Pl. XXXIII. figs. 6*a*, 6*b*; Pl. XXXIV. fig. 6.)

[Persian Gulf; coll. A. S. G. Jayakar; British Museum.]

Description.—The corallum rises from a thick explanate and encrusting base into massive knobs, ridged across the top and down the sides. These masses are 8 to 10 cm. high, and fuse irregularly together. The living layer extends over the whole mass.

The calicles are mostly under 1·5 mm., very pronounced or sharply depressed and polygonal. The walls are well marked, thin and sharp, faintly zigzag, very irregularly denticulate, and inclined to be membranous; the growing tips of the trabeculæ composing the wall are slightly flattened and frosted. The septa, with regular formula, yet have very irregular upper edges and outline. They seem only to appear some little distance below the edges of the sharp walls, and the granules and points which represent their upper edges together compose an irregular ring of small septal granules round an almost equally irregular but complete ring of pali. These granules and pali are ragged, irregular, frosted knobs, very loosely grouped, yet seen by the naked eye they appear fairly regular. The fossa is large and circular, with a frosted tubercle somewhat deep down. On the tops of the ridges the calicles frequently open in a streaming lamellate reticulum without denticulations or granules.

The section shows the axial streaming layer in which trabeculæ are barely distinguishable. These latter, however, become distinct and nodulated as they run out towards the sides, and are separated by straight rows of rounded pores.

The colour of the unbleached coral is a light, rather yellowish brown or buff. The colour penetrates about 3·5 mm. into the corallum.

This is the description of the most massive of the ridged specimens. It seems to have grown upon a cluster of large rounded pebbles, there being several separate patches of smooth

encrusting surface at one time in contact with stones or pebbles, while between these, small pebbles are seen embedded in the coral. The high, sharp walls make the calicles very conspicuous; they occur over the whole stock even down to the edge of the base; the surface is only smooth in the bases of deep valleys or clefts.

a. (Pl. XXXIII. fig. 6*a*.) Zool. Dept. 92. 1. 13. 9.

Forms with ridges broken up.—Two other forms with similar calicles but rising upon a different kind of base (dead previous growths) have the ridges more or less broken up into rather crowded clusters of rounded flat-topped and flattened knobs, though sometimes still running for 5 to 6 cm. as ridges. The presence of sediment in the valleys between the knobs suggests that this may have caused the breaking up of the corallum into so many separate flattened irregular stems. The walls flatten down quite early in this specimen because the sides all dip down into narrow clefts between the separate knobs and ridges. Where the walls are lower there is a tendency for the pali to become more conspicuous.

b. Zool. Dept. 92. 1. 13. 19.
c. Zool. Dept. 92. 1. 13. 17.
d. Part of *c*, in spirit. Zool. Dept. 92. 1. 13. 24.
e. Zool. Dept. 92. 1. 13. 4.
e_1 and e_2. Parts of *e*, in spirit. Zool. Dept. 92. 1. 13. 27.

Columnar forms.—In addition to the above are two large specimens from Muscat, consisting of clusters of knobbed and gradually swelling columns, smooth, round and narrow at the base, where they rise either from the thick encrusting layer, or from the tips of similar columns of a previous growth. These columns fuse and branch, but are full of interstices which run through the heart of the stock. The walls are either sharp and conspicuous over the whole stock down to the edge (cf. specimen *f* and one small patch of *g*), or else flatten out just below the tips of the columns (cf. the greater part of *g*).

f. (Pl. XXXIV. fig. 6.) Zool. Dept. 1900. 7. 9. 2.
g. Zool. Dept. 1900. 7. 9. 1.

Stunted forms.—There are three of these: they consist of dense clusters of short, stunted, fusing and branching columns, little more than stalked knobs, the tops of which are slightly flattened, and tend all round their edges to run out into smaller knobs. The stocks are full of interstices. The calicles have the typical sharp walls, but instead of the intra-calicular skeleton being deep down and ragged, it is high and flat, and with the ring of pali forming a central boss.

The question as to whether this ring of pali is a sufficiently marked character to justify the specimens being described under another heading, is apparently answered in the negative by the fact that here and there traces more or less marked of such rings occur on specimens *b* to *c*. The calicles down the sides are quite flush with the surface.

h. Zool. Dept. 92. 1. 13. 18.
j. In spirit. Zool. Dept. 92. 1. 13. 29.

The third is a small free stock which appears to have rested on the mud. It was collected at Muscat, at 6 fathoms, by Mr. R. Kirkpatrick. The calicles are slightly more typical in having the ring of pali less prominent than in *h* and *j*.

k. Zool. Dept. 1901. 3. 26. 1.

The last specimen is also from Muscat, and like the bulk of the specimens from the collection of Dr. Jayakar, of which it is one of the most remarkable. Its general growth-form is like *h* and *j*, but the branches are a little thinner and longer. But in its most striking character it shows a specialisation the exact opposite of that shown by *h* and *j*, for the walls of the calicles on the knobs are of great height, very sharp, and the calicles are gaping and deep, the septa sloping down irregularly into the fossa without any attempt to form pali. The figure is from the top of a column and shows several double calicles.

The interstices, which were naturally large, were often cavernous, owing to the destruction of stems by boring sponges. Many of the stems are hollowed out.

l. (Pl. XXXIII. fig. 6*b*.) In four pieces. And a box of smaller fragments. } Zool. Dept. 1900. 7. 9. 3.

245. **Porites Persia** (3)**2.** (*P. Persica secunda.*) (Pl. XXXV. fig. 20.)

[Persian Gulf, coll. A. S. G. Jayakar; British Museum.]

Description.—The corallum seems to have rested upon several objects (? pebbles) as a thick, irregular incrustation, from the sides and surface of which a cluster of stout separate fan-shaped knobs with constricted necks rise and bend into the perpendicular. Their tops are flattened, of irregular width up to 3 cm., and tend to rise into rounded eminences. The living layer extends about 9 cm., with a constant tendency to form a new creeping edge.

The calicles are small, about 1 mm. in diameter. Round the top edges of the ridges the walls are sharp and fairly pronounced; in details of structure they closely resemble those of *P. Persian Gulf 1.* The walls flatten down, and are a fine flaky reticulum just below the edges of the ridges, while the calicles on their tops open in a lamellate stroma.

This coral is so like specimen *a* of the preceding type in essentials that it must be regarded as a small calicled variety. It is a pertinent question to ask, when so many variations are grouped together under the last heading, Why should not this one be included among them? It is quite possible that it ought to have been so included. But all the different forms grouped under the last heading graded off into one another, and this one seems to stand alone.

a. Zool. Dept. 92. 1. 13. 13.

Fossils.—There are in addition three nodules from Guverchin Kala on Lake Urmi, which show traces of the texture of a Poritid skeleton, and which when writing Vol. IV. I put on one side as true *Porites*. Re-examination, however, now convinces me that at least one of them, the only one which shows any trace of the original surface, is a *Goniopora*, with the number of septa diminishing by forking near the wall.

Dr. Abich has also described nodular remains of *Porites* from the islands of the same lake, one set of which he thought was of the same species as Reuss' *Porites leiophylla* from the Vienna Basin. This latter coral is also a *Goniopora*, and we may assume that the said nodules belonged to that genus. (See Vol. IV. pp. 96, 123.)

One other group, however, may have been true *Porites*, and therefore must provisionally be recorded here under a separate heading.

246. **Porites Persia** $_{(3)}$**3.** (*P. Persica tertia.*)

[Islands of Lake Urmi (? Miocene), coll. Abich.]

Syn. *Porites polymorpha* Abich, Mem. Acad. Sci. St. Petersburg (vi.), ix. 1859, p. 102, pl. ix. fig. 1, *a*, *b*, *c*, *d*, *e*.

Description.—The corallum takes many forms, from encrusting to lobate and even branching.

The calicles are shallow and 2 mm. in diameter, and the walls are thick and porous, frequently appearing incomplete, so that the interseptal loculi of adjacent calicles communicate across. There are only twelve septa, with slightly granular edges. A lamellate streaming layer can be seen in the axis of the stems.

Stems of this coral are sometimes found hollowed out.

This coral must, at least provisionally, be classified here. The conditions of the septa were admittedly difficult to unravel. The result arrived at by Dr. Abich that they were twelve in number remains the last word, but does not fix the generic position (see Introduction, p. 12). We must further point out that the size of the calicles, 2 mm., is large for a true *Porites*.

Group VI.—RED SEA AND EGYPT.

247. **Porites Red Sea** $_{(9)}$**1.** (*P. Erythræa prima.*) (Pl. XXXIII. fig. 7.)

[Koseir,* coll. Klunzinger; British Museum.†]

Syn. *Porites solida* Klunzinger, Die Korallthiere des Rothen Meeres, ii. (1879) p. 42, pl. vi. fig. 14, pl. v. fig. 21.

Description.—The corallum is massive, often of immense size, convex or globular, with humpy and uneven surface.

The calicles are of unequal size, mostly 1·5 mm., very deep, except round the lower margin of the stock. The walls are thin, sharp, straight (not zigzag), membranous, here almost without perforations and consequently with nearly straight edge, there perforated and the edge broken up into frosted granules; here and there the wall proliferates into a small mass of reticulum, probably where a new bud is to appear. The septa are very thin, and their very

* On the outer slopes and ridges of the reef ("am Abhang und auf der Klippe oben") see Klunzinger, l. c.

† Other specimens are in the Berlin Museum.

broken and interrupted edges slope deep down into the calicle. Spikes or thin plates rise some way down, and form a large open ring, 9 to 12 in number, but these are not the typical pali, because the septa reach a large reticular columellar tangle, and do not appear to fuse at all in the typical manner. This ring probably corresponds to the septal granules. From the large, close, columellar tangle a minute central point frequently arises. The interseptal loculi form a neat symmetrical ring of small oval apertures, penetrating deeply into the corallum.

In sections the trabeculæ are irregularly stout and crowded; they tend to thicken, so that the inner parts of the stock are very dense. The colour is bluish-grey or yellowish-brown. But in taking the stocks out of the water, their upper parts appear violet or reddish (Klunzinger).

The living polyp passes from grey to yellow, with short, conical, yellow-brown tentacles, slightly lighter at the tips. In the upper parts of the stock the polyps are often more violet, with colourless tentacles. The mouth is slightly protuberant.

The above details as to the living polyp are taken from Dr. Klunzinger's text; the description of the fine details of the skeleton is based upon an examination of one of Dr. Klunzinger's original specimens which was acquired by the British Museum. The most remarkable point on this specimen is the primitive arrangement of the septa as so many separate lamellæ joining the large columellar tangle without fusing.

Dr. Klunzinger believes that this is the same coral as was mentioned by Forskål * in 1775 as var. *a* of his *Madrepora solida*, because on account of its toughness and abundance it is largely used for building purposes along the shores of the Red Sea, a fact which Forskål called attention to. Dr. Klunzinger suggests that Forskål's var. *b* is probably re-discovered in the coral which he has called "*P. lutea*" (see next heading). Further, as Dr. Klunzinger was able to examine Ehrenberg's † originals, there can be no doubt that, as he states, this is the same form as that writer called *Madrepora porites conglomerata*, although there is no special reason to believe that this was the same as Esper's ‡ *M. conglomerata*.

The name *solida* was also applied to an Atlantic-American form by Dr. Verrill. § Dr. Ortmann ‖ extended it to cover a form from Mauritius, which may eventually prove to be of the same species, but the evidence of mere resemblance is not sufficient in such variable forms as the stony corals.

Lastly, Dr. Rehberg ¶ gave the name "*solidus*" to a form from Zanzibar (see p. 229).

The specimen in the National Collection from which the figure is taken is a low, stunted column rising into nodules, the central and largest of which is flat-topped.

There is a specimen of this coral in the Paris Museum also obtained from Dr. Klunzinger, and carefully studied by the present writer, who finds in his notes that it somewhat resembles the next, which Dr. Klunzinger called *Porites lutea*.

a. From Dr. Klunzinger. Zool. Dept. 86. 10. 5. 12.

* Descriptio animalium, p. 131.

† Korallenthiere, 1834, p. 117.

‡ Esper described two *M. conglomeratæ*; the first was a *Goniopora*, the second a true *Porites*, but without recorded locality.

§ Trans. Conn. Acad. i. 1868, p. 358.

‖ Zool. Jahrb. (Syst.) iii. 1888, p. 157.

¶ Abh. Naturw. Verein Hamb. xii. 1892, p. 48.

248. **Porites Red Sea (9)2.** (*P. Erythrææ secunda.*) (Pl. XXXIII. figs. 8*a*, 8*b*.)

[Koseir, coll. Klunzinger; British Museum.*]

Syn. *Porites lutea* Klunzinger, Die Korallthiere des Rothen Meeres, ii. (1879) p. 40, pl. v. fig. 16.

Description.—The corallum is massive, often of immense size, convex, humpy, knobbed or club-shaped.

The calicles are shallow, as a rule not half so deep as broad—1·5–2 mm. across—smaller (1 mm.) in the depressions. The walls, which vary in thickness and are slightly echinulate, just raised above the level of the septa and pali, sometimes almost obsolete. In the former case the walls run as fine, sharp, polygonal lines, here and there ragged, and tending to be reticular. Septa twelve, uniform or only slightly unequal, with two to three minute points along their thin edges, which are often indistinct. On the other hand, the ring of pali (five to six) is always well developed, and visible to the naked eye, inasmuch as they rise above the edge of the septa. The columella is deep down in the fossa below the pali, and therefore not noticeable.

The colour in life is generally yellow, but also bluish, or violet, or else violet above but yellow round the base.

The British Museum obtained a specimen of this coral from Dr. Klunzinger. On comparing it with Dr. Klunzinger's description given above, I find the calicles are much smaller than in the type specimen, the average being hardly more than 1 mm. There are, however, a great number of double calicles with 24 septa; these reach nearly to 2 mm. in diameter. The walls differ also in that when simple, it is a very straggling, interrupted zigzag, when reticular, which it mostly is, this zigzag is completely lost, and no trace of a median line or ridge can be seen, the reticulum being open, loose, and composed of thin, wavy or angular filaments (fig. 8*a*). The septa are also thin, they unite in the typical manner, and at the same time join a columellar ring, which is at no place complete yet looks so when seen from above; the columellar tangle consists of this ring from which spokes run to a central rod or tubercle, which is frosted like the pali. The interseptal loculi form a symmetrical ring of deep oval holes. In the lateral calicles the elements are thicker and the pali well developed (fig. 8*b*).

This coral differs from *P. Red Sea 1* with which Forskål (according to Dr. Klunzinger) united it as var. *b* of his *Madrepora solida*, in having the shallow calicles and the more reticular walls, but the skeletal character of the septa, the large columellar tangle, and the symmetrical ring of pali are important features which they have in common. The development of the pali appears to be always co-ordinated with that of the walls (see Introduction, p. 18). The difference in the heights of the walls is apparently the only important distinction between *P. Red Sea 1* and *2* †. On the *Porites lutea* of Milne-Edwards and Haime with which Dr. Klunzinger would specifically associate this coral, see below (p. 244).

a. From Dr. Klunzinger. Zool. Dept. 86. 10. 5. 25.

* See note, p. 236.

† See observation under the last heading on the specimen of this coral in the Paris Museum.

249. Porites Red Sea (9)3. (*P. Erythrææ tertia.*)

[Red Sea, coll. Ehrenberg; Berlin Museum.]

Syn. *P. nodifera* Klunzinger, Die Korallthiere des Rothen Meeres, ii. (1879) p. 41, pl. vi. fig. 13, pl. v. fig. 17.

Description.—The corallum forms dendriform or tufted stocks, the branches dividing dichotomously. The terminal branches are bluntly digitiform, or shorter, lobulate, and often somewhat compressed. The stocks are from 3–12 cm. high, the branches 2–3 cm. broad, the terminal twigs 1–1·5 cm. across and 1–3 cm. high. The living layer is always confined to these last named.

The calicles are shallow, often almost superficial, 1–1·5 mm. across, 0·5–1 mm. deep. The walls are thin, almost trabecular—near the top with polygonal, often incomplete edges—"the walls are often not clearly separable from the septa." These latter are rather unequal, irregular, short, spiky, and trabecular. The ring of pali is not very conspicuous, often indistinct, since their trabeculæ frequently run in different directions. There is a central fossa within the ring of pali, but apparently without columella.

This is Dr. Klunzinger's description of a specimen (var. *β*) of Ehrenberg's *Porites clavaria* from the Red Sea, preserved in the Berlin Museum. The var. *α*, which was apparently based upon a figure of Savigny's in his Descr. de l'Egypt, pl. iv. fig. 6, is referred to in Vol. IV. p. 99, of this Catalogue.

Dr. Klunzinger compares it with Dana's *P. cylindrica* ("? Feejee Isl."). But the most striking characteristic of this latter species is the erect, neatly rounded stems, and the apparent absence of excavate cells. On the other hand, the limitation of the living layer to a depth of 1–2 inches is common to both.

Examination of Dr. Klunzinger's photographs shows that the thin wall is often zigzag, a phenomenon already frequently described in the genus *Goniopora*, and that between the ragged irregular septa the interseptal loculi are large and conspicuous, so that the calicle is distinct.

On Dr. Klunzinger's suggested identification of this coral with the var. *nana* of Lamarck's *Porites conglomerata*, see Part II., among the forms from unknown localities.

There is unfortunately no specimen in the British Museum from the Red Sea corresponding with this description. In the Paris Museum there is a specimen from the Seychelles labelled *P. nodifera*, but neither growth-form nor calicle structure corresponds with Dr. Klunzinger's description (see p. 223).

250. Porites Red Sea (9)4. (*P. Erythrææ quarta.*)

[Red Sea, coll. Klunzinger; Berlin Museum.]

Syn. *Synarœa undulata* Klunzinger, Die Korallthiere des Rothen Meeres, ii. (1879) p. 48, pl. vi. p. 12, pl. v. p. 30.

Description.—The corallum rises into erect lobes or columns, with uneven wavy sides, fusing into solid masses or separated; their tops rounded or fusing to form a gyrate crest.

The living layer extends downwards unevenly: surfaces raised into crowds of cœnenchymatous ridges 2 mm. high, blunt, rounded, bent and twisted in all directions.

The calicles are minute, mainly visible owing to the rings of pali, which are 0·5–0·75 mm. in diameter, unevenly distributed, mostly confined to the valleys, but now and then sunk in the ridges. The walls and whole surface are covered with minute echinulate granules. The septa are obscured; pali five to six, often slightly V-shaped, about the size of, and exactly similar to the rest of the surface granules. The columellar tubercle is hardly visible.

The colour is reddish violet, especially in the higher parts; below it is more yellowish. It occurs on the steep edge of the reef, frequently with Chama shells between the columns.

This *Porites* from the Red Sea is interesting, as showing the upheavals of cœnenchyma common in *Montipora* but only rarely seen in *Porites* (see Table IV.). The differences between these cœnenchymatous *Porites* are seen not only in the methods of growth, but also in the forms of the cœnenchymatous ridging. The characters of the calicles show that all these are true *Porites*, and that nothing is gained by making them into a separate genus (see p. 9).

251. **Porites Red Sea (9)5.** (*P. Erythrææ quinta.*) (Pl. XXXIII. fig. 9.)

[Koseir, coll. Klunzinger; Berlin Museum.]

Syn. *P. columnaris* Klunzinger, Die Korallthiere des Rothen Meeres, ii. (1879) p. 41, pl. viii. fig. 22, pl. v. fig. 19.

Description.—The corallum is almost always columnar, but sometimes also in mounds or tubers. Columns often 50–100 cm. high and 8–10 cm. across, generally narrowing towards the top like a blunt cone. The sides are irregularly swollen and humpy. The living layer extends nearly to the base of the column, at least 35 cm., the lower edge tending continually to creep downwards over the dead stock.

The calicles are moderately deep, very seldom flush with the surface, nearly uniform in size, rather large, 2 mm. across, 0·5–1 mm. deep. The walls are thin, fenestrated, at the top of the stock generally sharp and polygonal. Sometimes the upper edge is not single, and then no longer projects as a sharp ridge, but combined with the septa is round-topped and reticular. Septa somewhat irregular, unequal, trabecular, and spiky (dörnelig). The ring of four to five pali is conspicuous; there is a distinct columella.

In life the stock is of a brownish colour, but always deep black when dried. The black colouring matter reaches only 2 mm. below the surface.

The above is taken from Dr. Klunzinger's text and figures. Examination of the fragment obtained by the British Museum from Dr. Klunzinger shows also the following points:—

By far the larger part of the axis of the columns is occupied by a rather dense streaming reticulum of stout threads or flakes; round the periphery the trabeculæ bend outwards radially. These trabeculæ are rendered conspicuous by the fact that where the junctions occur they swell

into conspicuous nodules. Quite near the surface they become less marked, and the actual surface seems composed of a loose, open, streaming reticulum. The texture of the lateral calicles is quite flaky, the walls being built of flakes, arranged parallel, or at small angles, with the surface; the flakes are all pierced with round holes, and from their surfaces a delicate trabecular, slightly nodulated thread-work arises and forms the semi-reticular wall ridges, and the septa, which are thin with interrupted edges, and very perforated. The flakes are again seen in the columellar tangle. The pali and the columellar tubercle are small and inconspicuous. The interseptal loculi are neat, and form a symmetrical ring of deep oval holes (see Pl. XXXIII. fig. 9; cf. the same feature in *Porites Red Sea 1* and *2*).

I find these same features recorded in my notes of the Paris specimens, and they may be taken as definite structural characters of this form.

Dr. Klunzinger found it not uncommon in deep hollows under the surf, and on the outer slopes of the reef.

a. A fragment obtained from Dr. Klunzinger. Zool. Dept. 86. 10. 5. 39.

252. **Porites Red Sea (9)6.** (*P Erythrææ sexta.*)

[Red Sea; Stuttgart Museum.]

Syn. *Synarœa lutea* Klunzinger, Die Korallthiere des Rothen Meeres, ii. (1879) p. 49, pl. vii. fig. 4, pl. v. fig. 29.

Description.—The corallum is encrusting, with here and there smooth free edges supported by well developed epitheca. The surface is wavy, and raised into cœnenchymatous ridges, which run in wavy tracts like veins.

The calicles are ill defined, with however, conspicuous rings of pali which are 0·5–0·75 mm. across, very numerous, not developed on the cœnenchymatous ridges, and not in rows. The septa meet and fuse, and the pali are coarse and V-shaped, with conspicuous interseptal loculi running into the small open fossa, or over the wall, among the rough finely echinulate granules which cover the surface.

The original specimen of this coral, described and figured by Dr. Klunzinger, is in the Stuttgart Museum; it is 20 cm. long, and the surface is crumpled so as to rise from 1–3 cm. There appears to be only one specimen known.

It differs in the characters of its cœnenchymatous upheavals from any other known cœnenchymatous *Porites*. (For other forms, see Table IV.)

253. **Porites Red Sea (9)7.** (*P. Erythrææ septima.*)

[Near Koseir, coll. Klunzinger; Berlin Museum.]

Syn. *P. echinulata* Klunzinger, Die Korallthiere des Rothen Meeres, ii. (1874) p. 43, pl. v. fig. 18.

Description.—The stocks are explanate, very small, 1·5–3 cm. diameter, with free edges; the centre somewhat gibbous; the edge is 1–2 mm. thick and supported by epitheca.

The calicles round the edges are superficial, but in the raised central regions depressed or crater-like (1–1·5 mm. across). The walls are thick, granular and echinulate, and hardly distinguishable from the septa. Every part of the surface is covered with fine granules running out into sharp points. The granules which form the ring of pali (four to five) are especially large and prominent, and the ring is therefore very conspicuous. There is no visible columella.

The colour is grey or yellow. It is found on old branches of coral, but not common.

This is Dr. Klunzinger's original description simply rearranged. He further adds that the coral, but for the presence of the wall, would greatly resemble a *Psammocora*. We can gather further important details from the photographs. (1) On the higher parts of the stock the wall is round-topped and swollen; (2) the radial symmetry is irregular; (3) the septa appear to meet and fuse; and (4) frequently only six large interseptal loculi are present.

There is no specimen of this *Porites* in the National Collection. Its small size and the irregularity of its calicular skeleton suggest the possibility of its being merely a young stage of some larger form. But on the other hand its position on dead branches of other corals may indicate special adaptation to such a habit.

254. Porites Red Sea (9)8. (*P. Erythrææ octava.*)

[Red Sea, coll. Botta; Paris Museum.]

Syn. *Porites alveolata* Milne-Edwards and Haime, Les Coralliaires, iii. (1860) p. 178.
? *Porites alveolata* Klunzinger, Korallthiere des Rothen Meeres, ii. (1879) p. 43, pl. v. fig. 20.

I examined three specimens labelled *P. alveolata* in the Paris collection. They represented two, in my judgment, distinct forms. Comparison with the original description led to the conclusion that the two specimens, Nos. Z 197 *a* and *b*, were those on which the description was based. This can now be amplified.

Description.—The corallum is massive, sometimes with gibbous or lobed surface. The living layer extends very unevenly downwards, and is closely adherent.

The calicles are very deep, from sub-circular to angular, about 1 mm. in diameter. The walls are straight and thin, often with median thread. The septa are visible near the edges as points and granules, but soon project as thin very ragged spikes and ridges; some send up isolated pali, others not, most of them losing themselves in a columellar tangle, which is loose and open at first, but gradually becomes more compact. The pali are only suggested, except in the shallower calicles down the sides, where they develop into typical rings in which the four lateral principals are large and conspicuous. The central fossa may be large and open.

The two specimens have very different growth-forms, the one being a rounded mass with knobbed surface, and the other a smooth-topped mass like a tableland, the living layer on some sides of which creeps smoothly and steeply down for 14 cm. The calicles on the top open in a loose, angular reticulum.

Dr. Klunzinger gives an illustration, but without description, of a specimen which he thought was the same, as indeed it may have been (see his pl. v. fig. 20).

There are two words in the original description which require comment. The corallum is said to be "encrûtant" and the walls of the calicles to be thick. The first word had reference clearly to the appearance presented by the living layer, which appeared to the author to form an encrusting cap over a massive stock. It was obviously the last of the free edges which led the early observers astray (see the Introduction to Vol. IV. p. 24, fig. 2, A, B). The word encrusting, as it is now used, only applies to the ultimate form of the stock. The ultimate form of Milne-Edwards' *P. alveolata* is massive, as might have been gathered from his description, for he adds that the encrusting living layer builds up massive stocks.

It is difficult to know exactly what he meant by the walls being "épaisses." For Dr. Klunzinger, like myself, found them thin. According to the modern terminology, the walls are only thick when they are reticular. Milne-Edwards probably meant that the skeletal elements of the simple wall were stout, and that is the character seen in Dr. Klunzinger's photograph.

There is no specimen of this in the National Collection. Its resemblance to the British Museum specimen of *P. Red Sea 1*, which was one of Dr. Klunzinger's *P. solida*, cannot be overlooked.

255. **Porites Red Sea** (9)**9**. (*P. Erythrææ nona.*)

[Red Sea, coll. Klunzinger; Berlin Museum.]

Syn. *Stylarœa punctata* Klunzinger, Die Korallthiere des Rothen Meeres, ii. (1879) p. 44, pl. v. fig. 27.*

Description.—The corallum forms small, somewhat convex, encrusting colonies.

The calicles are deep. The walls are stout, porous, trabecular, or echinulate. The septa are slight ridges projecting from the wall. There is no trace of pali, but a columellar tubercle rises in the centre.

On account of these two last-named features Dr. Klunzinger suggested the establishment of a new genus, as was done by Milne-Edwards and Haime and then retracted—for details see under *P. Moluccas 1* (= Espers' *Madrepora punctata*). But there can be no question in my mind from a study of Dr. Klunzinger's photograph that this is a young colony of *Porites*, in which the calicles are small and crowded and the intra-calicular skeleton deficient, as is commonly the case in very young colonies of *Porites*. The walls show quite the typical *Porites* wall, being a zigzag so irregular as almost to pass into a reticulum. The absence of pali is usual in deep calicles throughout the whole genus, while the early appearance of the columellar tubercle in the development of the complete intra-calicular skeleton need have no special significance. Dr. Klunzinger identifies his own specimens with others of Ehrenberg, as already described on p. 161. (See *P. Moluccas 1.*)

* From Dr. Klunzinger's text it was difficult to decide whether the photograph was not of one of Ehrenberg's specimens. But in the description of the plates he adds "aus meiner Sammlung."

Notes on Milne-Edwards' References to the Occurrence of the Species *P. conglomerata, P. lutea* and *P. arenosa* in the Red Sea.

I would greatly prefer not having to pen the next few paragraphs. The more I work at the corals and realise the difficulty of the work, the more have I seen to admire in the classical work of Milne-Edwards and Haime. If now I have to point to a few cases of "oversight" or "accidental mistake," I do so without any disrespect to the learned authors, to whose pioneer work we owe so much, and simply because it comes right in the path of this volume. Even then, however, it might have been possible to slur them over in some way, but my attempt to find a scientific method of dealing with the facts compels me to point out how a bad system must almost necessarily lead the greatest of men into lapses from strict accuracy. There is something heroic in absolute intellectual honesty at all times, and even under the best of systems it is hardly to be expected. All the more urgent is it to have a system which shall not positively invite us to leave the solid facts and start guessing at the genetic affinities within a group like the corals. I have no hesitation in saying that all the so-called established species are purely fanciful. I only regret that the lapses which I have now to mention were made by the greatest of the pioneers in coral morphology.

Under the name *P. conglomerata* Milne-Edwards (Les Cor. iii. p. 177) describes a form from the Red Sea. I failed to find the original of this in the Paris Museum. He refers, in his synonymy of the form, both to Esper's *M. conglomerata* (Suppl. i. pl. 59 A), and to Lamarck's *Porites conglomerata*, but this latter had reference only to Esper's fig. 59 A. Lamarck does not appear to have had any specimen. If he had had, considering that his var. 1 and var. 2 are still preserved, we should expect to have found it. It is then difficult to ascertain what Milne-Edwards was describing, and where he obtained his details. For such details as he gives are not to be found in Esper's figure or text. A possible solution may be found in the facts (1) that in his earlier paper on the Poritidæ in the Ann. Sci. Nat. 1851, he, in conjunction with Haime, gave Lamarck's *P. astræoides* as one of the synonyms of Esper's coral. Now Lamarck's *P. astræoides* is still preserved in the Paris Museum, and it was this that they described, adding, partly on the authority of Ehrenberg, that the species *conglomerata* occurred in the Red Sea; but (2) in 1860, Milne-Edwards admitted *astræoides* and *conglomerata* as two distinct species, and consequently removed the specimen of the former he had described as *conglomerata*, and put it under *astræoides*, but he left its description still as the description of *conglomerata*. There is thus a detailed description of a Red Sea form which has never had any existence, the printed description having been borrowed from a West Indian form.

I should certainly have concluded that there was some mistake in this charge had not the following cases been equally confusing.

In 1851, Milne-Edwards and Haime gave a description of the species *Porites lutea*. It occurred at Tongatabu, and according to Dana at Fiji. There is still a specimen of Quoy and Gaimard, "*Porites conglomerata*" (Tongatabu), labelled *P. lutea*, but this is not the one described by Milne-Edwards and Haime, for it has calicles only 0·75 mm. in diameter, while in the said description the calicles are given as 1 to 1·5 mm. in diameter. As this happens to be about the size of the calicles of Dana's *Porites conglomerata*, we are left to conclude that Milne-Edwards and Haime's description was founded upon Dana's work. Here there were apparently two quite distinct corals drawn in under one name. But that was not enough. In 1860, Milne-Edwards, leaving the description unaltered, included certain *Porites* from the Red Sea,

where he said the species was common. I have studied all the *Porites* labelled *lutea* in the Paris Museum, to some of which at least he must have been referring, but I cannot find any at all which correspond with the old description.

If this is the history of the Milne-Edwards species "*lutea*," what, we ask, can be the value of the many "identifications" with it which have been made since by others who have also not seen their way to escape from these ensnaring names?

A third case equally puzzling is supplied by the *Porites arenosa*, which Milne-Edwards in 1860 announced as from the Red Sea, as well as from the Seychelles, l'île Bourbon, Vanikoro, etc. If we wish to know on what actual specimen the description is founded, we turn to the Ann. Sci. Nat. of 1851, xvi. p. 29, and find that it referred to some specimen of Quoy and Gaimard, and also to specimens in the Paris Museum, which Lamarck had called by the equivalent name *arenacea*. They added, "Lamarck l'indique probablement à tort comme provenant de la mer rouge et de l'océan indien." But Lamarck's type is apparently still preserved, for in the Paris Museum there is a very old and worn specimen (Z 180 *d*), which closely resembles one of the specimens in the possession of the National Collection from the Pearl Bank, Ramesvaram. It not only encrusts a pearl shell, but the tips of the walls are flat, and striated across, cf. *P. Ceylon 12*. Lamarck's indication of the locality was, therefore, not so wrong as Milne-Edwards and Haime suggested. There are two other specimens of *arenacea* in the Paris Museum, said to belong to Lamarck's collection, but I cannot discover reference to them in any of the descriptions.

Besides the reference to Lamarck's specimen or specimens, Milne-Edwards and Haime referred primarily to Quoy and Gaimard, and we find that there still exists a specimen called *arenosa* from Vanikoro, labelled Quoy and Gaimard (Z 180 *b*). This, one would think, should be the actual specimen described in the Mon. des Poritides in 1851. But from my notes I gather that the calicles of that specimen are from 0·75 to 0·8 mm., while in the description the diameter of the larger calicles is given as 1·5 mm. The description does not, therefore, refer to Quoy and Gaimard's specimen. Further, a glance at Esper's original figure shows that the description did not refer to that. I have, therefore, been totally unable to find out what the actual specimen described was. Nor do I believe that it referred to any of the specimens now labelled *arenosa* from the Red Sea, because that locality is not given in the Mon. des Poritides in which the description first appeared.

These are but samples of the confusion which has resulted from the reckless application of well-known names, a confusion which is worse confounded with every new systematic work in which the genus is dealt with on old lines.

EGYPTIAN FOSSIL FORMS.

There can be little doubt that the Egyptian Tertiary formations will ultimately yield a rich harvest of Tertiary Poritids. For besides the form described by Dr. Felix as *Porites pusilla*, he mentions others which he identified with Catullo's *P. ramosa*, Reuss' *P. polystyla*, and Defrance's *P. incrustans*.

With reference to the three last named, Catullo's *ramosa* was apparently a *Goniopora*, see Vol. IV. p. 107. *P. polystyla* Reuss, is a remarkable form, as to the affinities of which I am

unable to come to any immediate decision, except that it is *not* a *Porites*. The enigmatical *P. incrustans* has been a snare for generations (see Vol. IV., p. 117). But while the species-names chosen by Dr. Felix for his specimens are of such little value for his purpose, it is quite possible that his forms were true *Porites*. We gather, however, that they were for the most part so badly preserved, that it is doubtful whether we shall ever discover their immediate affinities.

256. **Porites Egypt** (1)**1**. (*P. Egyptiaca prima.*)

[Wadi Ramlieh, Arabian Desert of Middle Egypt; Cairo Museum.]

Syn. *Porites pusilla* Felix, Zeits. Deutsch. Geol. Gesellschaft, xxxvi. (1884) p. 445, pl. v. fig. 6.

Description.—The corallum is mound-like or somewhat expanded, with surface convex.

The calicles are crowded, about 1 mm. in diameter, shallow, irregularly polygonal. The walls have sharp, conspicuous edges. The septa, mostly twelve in number, with granular edges. In the centre of the calicle a ring of pali surrounds a slightly developed columellar tubercle.

Dr. Felix's figure shows the septa rather wavy and granular. The palic formula cannot be made out. There is no reason to doubt that this is a true *Porites*.

PORITES OF THE INDO-PACIFIC REGION.

ANALYTICAL TABLES OF THE RESULTS

WITH OBSERVATIONS.

[N.B.—The positions in these Tables of any of the described forms can be found by consulting the Index.]

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3	*Society Islands 3*, Tahiti, ? Papeete Reefs.			Pl. I. figs. 3, 4, 5; Pl. X. fig. 5	Brit. Mus. & (Camb. Univ. Mus.)	30
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9	*Tonga Islands 4*, Tongatabu			Pl. I. fig. 9; Pl. XIII. fig. 4	Brit. Mus.	36
10	*Tonga Islands 5*, Tongatabu			Pl. II. fig. 1; Pl. XIII. fig. 5	Brit. Mus.	37
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12	*Tonga Islands 7*, Tongatabu			Pl. II. figs. 3, 4	Brit. Mus.	38
13	*Tonga Islands 8*, Tongatabu			Pl. II. figs. 5, 6; Pl. X. fig. 6	Brit. Mus.	39
14	*Tonga Islands 9*, Tongatabu			Pl. II. fig. 7; Pl. X. fig. 7	Brit. Mus.	41
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16	*Fiji Islands 1*, Totoya	17 fathoms		Pl. II. fig. 9; Dana's Zoophytes, pl. liv. figs. 5*a*, 5*b*, 5*c*, 5*d*.	Brit. Mus.	43
17	*Fiji Islands 2*, Kandavu			Pl. III. figs. 1, 2, 3, 4; Pl. XI. fig. 3.	Brit. Mus.	44
18	*Fiji Islands 3*, Wakaya			Pl. III. fig. 5; Pl. XIII. fig. 7	Brit. Mus.	46
19	*Fiji Islands 4*, Wakaya Reefs	Lagoon		Pl. III. figs. 6, 7; Pl. XIII. fig. 8	Brit. Mus.	46
20	*Fiji Islands 5*, Kandavu and Wakaya Reefs.			Chall. Rep. pl. xi. figs. 2, 2*a*, 4, 4*a*	Brit. Mus.	47
21	*Fiji Islands 6*, "Feejee Islands"			Pl. III. fig. 8; Pl. XIII. fig. 9	Brit. Mus.	49
22	*Fiji Islands 7*, "Fiji Reefs"			Pl. III. fig. 9; Pl. XIII. fig. 8	Brit. Mus.	50
23	*Fiji Islands 8*, "Feejee Islands"			Dana's Zoophytes, pl. lv. figs. 1, 1*a*, 1*b*, & pl. liii. fig. 9.	?	51
24	*Fiji Islands 9*, "Feejee Islands"			Dana's Zoophytes, pl. liv. figs. 6, 6*a*.	(Paris Mus.)	51
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33	*Fiji Islands 18*, Rotuma, Reef near Solkopi.			Pl. IV. fig. 1; Pl. XIII. fig. 10	Brit. Mus.	56
34	*Fiji Islands 19*, Rotuma, Reef near Solkopi.			Pl. IV. figs. 2, 3, 4; Pl. XIII. fig. 11; Proc. Zool. Soc. (1898) pl. xxiv. figs. 1*b*, 2.	Brit. Mus.	57
35	*Fiji Islands 20*, Rotuma, "Boat Channel."	Under 8 feet at low tide		Pl. IV. fig. 5	Brit. Mus.	59
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37	*Fiji Islands 22*, Rotuma			Pl. IV. figs. 7, 8; Pl. XIII. fig. 8	Brit. Mus.	60
38	*Fiji Islands 23*, Rotuma			Pl. IV. fig. 9	Brit. Mus.	61
39	*Fiji Islands 24*, Rotuma	3 fathoms		Pl. V. fig. 1; Pl. XIII. fig. 13; Proc. Zool. Soc. (1898) pl. xxiv. figs. 1, 8.	Brit. Mus.	62
40	*Ellice Islands 1*, Funafuti	Lagoon, 7 fathoms.		Pl. V. fig. 2; Pl. XIII. fig. 14	Brit. Mus.	63
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42	*Ellice Islands 3*, Funafuti	Lagoon shoals.		Pl. V. figs. 4, 5; Pl. XI. fig. 2; Proc. Zool. Soc. (1898) pl. xxiv. figs. 1*d*, 3.	Brit. Mus. & (Camb. Univ. Mus.)	65
43	*Ellice Islands 4*, Funafuti			Pl. V. fig. 6; Pl. XIII. fig. 16	Brit. Mus.	67
44	*Ellice Islands 5*, Funafuti	Lagoon		Pl. V. figs. 7, 8, 9; Pl. XIII. fig. 8.	Brit. Mus.	67
45	*Ellice Islands 6*, Funafuti	Lagoon		Pl. VI. figs. 1, 2	Brit. Mus.	69
46	*Ellice Islands 7*, Funafuti	Lagoon		Pl. VI. fig. 3	Brit. Mus.	70
47	*Ellice Islands 8*, Funafuti	Lagoon		Pl. VI. fig. 4; Pl. XIII. figs. 17, 18.	Brit. Mus.	70
48	*Ellice Islands 9*, Funafuti	Lagoon		Pl. VI. figs. 5, 6	Brit. Mus.	72
49	*Ellice Islands 10*, Funafuti	Lagoon		Pl. VI. figs. 7, 8; Pl. XIII. fig. 19	Brit. Mus.	73
50	*Ellice Islands 11*, Funafuti	Lagoon		Pl. VI. fig. 9; Pl. VII. fig. 1; Pl. XIII. fig. 20.	Brit. Mus.	74
51	*Ellice Islands 12*, Funafuti	Lagoon		Pl. VII. figs. 2, 3; Pl. XIII. fig. 21.	Brit. Mus.	75
52	*Ellice Islands 13*, Funafuti			Pl. VII. figs. 4, 5; Pl. XIII. fig. 22.	Camb. Univ. Mus.	76
53	*Ellice Islands 14*, Funafuti	Lagoon		Pl. VII. fig. 6; Pl. XIII. figs. 23*a*, 23*b*.	Brit. Mus.	77
54	*Ellice Islands 15*, Funafuti	7 fathoms		Pl. VII. fig. 7	Camb. Univ. Mus.	77
55	*Ellice Islands 16*, Funafuti			Pl. VII. fig. 8; Pl. XIII. fig. 24.	Brit. Mus.	78
56	*Ellice Islands 17*, Funafuti			Pl. VII. fig. 9; Pl. XIII. fig. 25.	Brit. Mus.	79
57	*New Hebrides 1*, Api			Pl. VIII. fig. 1; Chall. Rep. xvi. pl. xi. figs. 8, 8*a*.	Brit. Mus.	81
58	*Queen Charlotte Islands 1*, Vanikoro			Voy. de l'Astrolabe, Zooph. Atl. pl. xviii. figs. 6, 7, 8.	? Paris Mus.	82
59	*Solomon Islands 1*, Sta. Anna Island.			Pl. IX. fig. 1	Brit. Mus.	83
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64	*Solomon Islands 6*, Shortland Island.			Pl. VIII. figs. 5, 6; Pl. XI. fig. 6	Brit. Mus.	86
65	*Solomon Islands 7*, Choiseul Bay			Pl. VIII. fig. 4; Pl. XIII. fig. 28	Brit. Mus.	87
66	*Solomon Islands 8*, Choiseul Bay			Pl. VIII. fig. 7; Pl. XIII. fig. 27	Brit. Mus.	88
67	*Solomon Islands 9*, Solomon Islands			Pl. VIII. fig. 8; Pl. XI. fig. 7	Brit. Mus.	89
68	*Solomon Islands 10*, Kaiserin Augusta Bay, Bougainville.				Berlin Mus.	89
69	*New Ireland 1*				Paris Mus.	90
70	*New Guinea 1*, Galewo Straits				Berlin Mus.	91
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76	*Caroline Islands 3*, Ponapé			Pl. IX. figs. 5, 6; Pl. XII. figs. 1, 2, 3.	Brit. Mus.	94
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96	*Great Barrier Reef 3*, Capricorn Islands.			Pl. XIV. fig. 3; Pl. XIX. fig. 1.	Brit. Mus.	111
97	*Great Barrier Reef 4*, Capricorn Islands.			Pl. XIV. fig. 4; Pl. XIX. fig. 2.	Brit. Mus.	111
98	*Great Barrier Reef 5*, Capricorn Islands.			Pl. XIV. fig. 5; Pl. XIX. fig. 3.	Brit. Mus.	112
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100	*Great Barrier Reef 7*, Palm Islands			Pl. XIV. fig. 7; Pl. XXI. fig. 3.	Brit. Mus.	114
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102	*Great Barrier Reef 9*, Palm Islands			Pl. XIV. fig. 9; Pl. XIX. fig. 5.	Brit. Mus.	116
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106	*Great Barrier Reef 13*, Green Island.			Pl. XV. fig. 3; Pl. XXI. fig. 5.	Brit. Mus.	119
107	*Great Barrier Reef 14*, Rocky Island.			Pl. XV. fig. 4; Pl. XXI. figs. 6, 7	Brit. Mus.	119
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138	*North Australia 1*, Port Essington			Pl. XXII. fig. 2; Pl. XXIV. fig. 1	Brit. Mus.	145
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140	*North Australia 3*, Franklin Shoal, Arafura Sea.	9 fathoms		Pl. XXII. fig. 4; Pl. XXV. fig. 14.	Brit. Mus.	147
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144	*North Australia 7*, Evans Bank, Arafura Sea.	15 fathoms		Pl. XXII. fig. 8; Pl. XXIV. fig. 6	Brit. Mus.	150
145	*North Australia 8*, Parry Shoal, Arafura Sea.	12 fathoms		Pl. XXII. fig. 9; Pl. XXIV. fig. 4	Brit. Mus.	151
146	*North-West Australia 1*, Bassett-Smith Shoal, Holothuria Bank.	9 fathoms		Pl. XXIII. fig. 1	Brit. Mus.	152
147	*North-West Australia 2*, Holothuria Bank.			Pl. XXIII. fig. 2; Pl. XXXV. fig. 2.	Brit. Mus.	153
148	*North-West Australia 3*, Baudin Island Reef.			Pl. XXIII. figs. 3, 4	Brit. Mus.	153
149	*North West Australia 4*, Baudin Island Reef.			Pl. XXIII. fig. 5; Pl. XXXV. fig. 1.	Brit. Mus.	154
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159	*Philippines 2*, Sooloo Sea			Dana's Zoophytes, pl. lv. figs. 8, 8*a*.		163
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162	*Philippines 5*			Pl. XXV. fig. 6; Pl. XXXV. fig. 8	Brit. Mus.	165
163	*Philippines 6*, Zamboanga			Pl. XXV. figs. 6, 7, 8; Chall. Rep. xvi. pl. xi. figs. 3, 3*a*.	Brit. Mus.	165
164	*China Sea 1*, ? Liu-Kiu Islands					166
165	*China Sea 2*, Hong Kong					167
166	*China Sea 3*, Macclesfield Bank	30–34 fathoms		Pl. XXV. fig. 9	Brit. Mus.	167
167	*China Sea 4*, Macclesfield Bank	23–40 fathoms		Pl. XXVI. figs. 1, 2, 3; Pl. XXXV. fig. 9.	Brit. Mus.	168
168	*China Sea 5*, Macclesfield Bank	13 fathoms		Pl. XXVI. fig. 4	Brit. Mus.	169
169	*China Sea 6*, Macclesfield Bank	17 fathoms		Pl. XXVI. fig. 5	Brit. Mus.	170
170	*China Sea 7*, Macclesfield Bank	17 fathoms		Pl. XXVI. fig. 6	Brit. Mus.	171
171	*China Sea 8*, Macclesfield Bank	17 fathoms		Pl. XXVI. fig. 7	Brit. Mus.	172
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173	*China Sea 10*, Macclesfield Bank	17 fathoms		Pl. XXVI. fig. 9; Pl. XXXV. fig. 10.	Brit. Mus.	173
174	*China Sea 11*, Tizard Bank	Lagoon, 6 fathoms.		Pl. XXVII. fig. 1	Brit. Mus.	174
175	*China Sea 12*, Tizard Bank	3 feet		Pl. XXVII. fig. 2	Brit. Mus.	175
176	*China Sea 13*, Tizard Bank	6–7 fathoms		Pl. XXVII. fig. 3; Pl. XXXV. fig. 11.	Brit. Mus.	176
177	*China Sea 14*, Tizard Bank	2–5 fathoms		Pl. XXVII. fig. 4; Pl. XXXV. fig. 13.	Brit. Mus.	177
178	*China Sea 15*, Tizard Bank, Itu Aba.	2 fathoms		Pl. XXVII. fig. 5; Pl. XXXV. fig. 27.	Brit. Mus.	178
179	*China Sea 16*, Tizard Bank, Sand Kay.	3 feet		Pl. XXVII. fig. 6; Pl. XXXV. fig. 16.	Brit. Mus.	179
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181	*China Sea 18*, Tizard Bank, Itu Aba, South Side.	2–5 fathoms		Pl. XXVII. fig. 8; Pl. XXIX. fig. 3.	Brit. Mus.	180
182	*China Sea 19*, Tizard Bank, Sand Kay.	3 feet		Pl. XXVII. fig. 9	Brit. Mus.	181
183	*Singapore 1* (West)			Pl. XXVIII. fig. 1; Pl. XXXV. fig. 19.	Brit. Mus.	182
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185	*Singapore 3*			Pl. XXVIII. fig. 3; Pl. XXXV. fig. 15.	Brit. Mus.	184
186	*Singapore 4* (West)			Pl. XXVIII. fig. 4; Pl. XXXV. fig. 21.	Brit. Mus.	185
187	*Singapore 5* (West)			Pl. XXVIII. figs. 5*a*, 5*b*; Pl. XXIX. fig. 4.	Brit. Mus.	186
188	*Singapore 6*			Pl. XXVIII. fig. 6; Pl. XXIX. fig. 5.	Brit. Mus.	186
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194	*Christmas Island 2*, Sea Cliff, Rocky Point, North Coast.		Pleistocene	Gregory, fig. 7, p. 222, Monograph of Christmas Island.	Brit. Mus.	192
195	*Christmas Island 3*, Inland Cliff, North Coast.		Pleistocene	Gregory, fig. 6, p. 222, Monograph of Christmas Island.	Brit. Mus.	194
196	*Christmas Island 4*, Rocky Point.		Pleistocene	Gregory, fig. 5, p. 222, Monograph of Christmas Island.	Brit. Mus.	196
	Kokos Islands 1			Pl. XXX. fig. 1.	Brit. Mus.	196
197	*Ceylon 1*, Ramesvaram			Pl. XXX. fig. 8; Pl. XXXV. fig. 29.	Brit. Mus.	197
198	*Ceylon 2*, Ramesvaram			Pl. XXX. fig. 3; Pl. XXXV. fig. 30.	Brit. Mus.	198
199	*Ceylon 3*, Ramesvaram			Pl. XXX. fig. 4	Brit. Mus.	199
200	*Ceylon 4*, Ramesvaram			Pl. XXX. fig. 5; Pl. XXXV. fig. 31.	Brit. Mus.	199
201	*Ceylon 5*, Ramesvaram			Pl. XXX. fig. 6	Brit. Mus.	201
202	*Ceylon 6*, Ramesvaram			Pl. XXX. fig. 7	Brit. Mus.	201
203	*Ceylon 7*, Ramesvaram			Pl. XXX. fig. 2; Pl. XXXV. fig. 22.	Brit. Mus.	202
204	*Ceylon 8*, Ramesvaram			Pl. XXX. fig. 9	Brit. Mus.	203
205	*Ceylon 9*, Ramesvaram			Pl. XXXI. fig. 1	Brit. Mus.	205
206	*Ceylon 10*, Pearl Bank, Rameswaram.			Pl. XXXI. fig. 2	Brit. Mus.	206
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208	*Ceylon 12*, Pearl Bank, Rameswaram.			Pl. XXXI. fig. 3; Pl. XXXV. fig. 17.	Brit. Mus.	207
209	*Ceylon 13*, Ramesvaram	Sub-fossil reef		Pl. XXXI. fig. 4; Pl. XXXV. fig. 23.	Brit. Mus.	208
210	*Ceylon 14*, Ramesvaram	Sub-fossil reef			Brit. Mus.	209
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212	*Ceylon 16*, Galle			Pl. XXXI. fig. 5	Brit. Mus.	210
213	*Ceylon 17*, Galle				Brit Mus.	211
214	*Ceylon 18*, Galle			Pl. XXXI. fig. 6	Brit. Mus.	211
215	*Ceylon 19*, between Galle and Belligam.				Mus. Zool. Inst. Jena	212
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220	*Maldives 2*			Pl. XXXI. fig. 8; Pl. XXXIV. fig. 3.	Brit. Mus.	214
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222	*Diego Garcia 1*			Pl. XXXII. fig. 1	Brit. Mus.	216
223	*Diego Garcia 2*			Pl. XXXII. fig. 2	Brit. Mus.	216
224	*Diego Garcia 3*			Pl. XXXII. fig. 3; Pl. XXXIV. fig. 4.	Brit. Mus.	217
225	*Rodriguez 1*			Pl. XXXII. fig. 4	Brit. Mus.	218
226	*Rodriguez 2*			Pl. XXXII. fig. 5; Pl. XXXV. fig. 28.	Brit. Mus.	219
227	*Mauritius 1*			Pl. XXXII. fig. 6	Brit. Mus.	220
228	*Mauritius 2*				Brit. Mus.	220
229	*Mauritius 3*			Pl. XXXII. fig. 7; Pl. XXXIV. fig. 5.	Brit. Mus.	221
230	*Mauritius 4*			Pl. XXXII. fig. 8; Pl. XXXIV. fig. 2.	Brit. Mus.	221
231	*Mauritius 5*			Pl. XXXII. fig. 9; Pl. XXXIV. fig. 1.	Brit. Mus.	222
232	*Seychelles 1*				Paris Mus.	223
233	*Amirantes 1*, Darros Island	22 fathoms		Pl. XXXIII. fig. 1	Brit. Mus.	224
234	*Amirantes 2*, African Island	10 fathoms		Pl. XXXIII. fig. 2	Brit. Mus.	224
235	*Amirantes 3*, Marie Louise Island	17 fathoms		Pl. XXXIII. fig. 3; Pl. XXXV. fig. 26.	Brit. Mus.	225
236	*Providence Island 1*	19 fathoms		Pl. XXXIII. fig. 4; Pl. XXXV. fig. 25.	Brit. Mus.	227
237	*Providence Island 2*	19 fathoms		Pl. XXXIII. fig. 5; Pl. XXXV. fig. 12.	Brit. Mus.	227
238	*Madagascar 1*, Nossibé			Abhandlung. Hamb. xii. (1892), pl. iii. figs. 4, 5, 6.	Hamburg Mus.	228
239	*Zanzibar 1*				Hamburg Mus.	229
240	*Zanzibar 2*				Hamburg Mus.	229
241	*Dar-es-Salaam 1*, Ras Rangoni	Among "sea-grass" on sand.			?	230
242	*Cape of Good Hope 1*	? On coarse sand.			Brit. Mus.	231
	V. India and Persia.					
243	*Sind 1*, Kurrachee		Tertiary Eocene		Brit. Mus.	232
244	*Persia 1*, Persian Gulf			Pl. XXXIII. fig. 6*a*, 6*b*; Pl. XXXIV. fig. 6.	Brit. Mus.	233
245	*Persia 2*, Persian Gulf			Pl. XXXV. fig. 20	Brit. Mus.	235
246	*Persia 3*, Lake Urmi		? Miocene	Mem. Acad. Sci. St. Petersburg (1859), ix. pl. ix. figs. 1*a*, 1*b*, 1*c*, 1*d*, 1*e*.	St. Petersburg	236

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248	*Red Sea 2*, Koseir			Pl. XXXIII. figs. 8*a*, 8*b*; Klunzinger's Korallthiere, ii. pl. v. fig. 16.	Berlin Mus. & (Brit. Mus.)	238
249	*Red Sea 3*			Klunzinger's Korallthiere, ii. pl. vi. fig. 13, pl. v. fig. 17.	Berlin Mus.	239
250	*Red Sea 4*			Klunzinger's Korallthiere, ii. pl. vi. fig. 12, pl. v. fig. 30.	Berlin Mus.	239
251	*Red Sea 5*, Koseir			Pl. XXXIII. fig. 9; Klunzinger's Korallthiere, ii. pl. viii. fig. 22, pl. v. fig. 19.	Berlin Mus. & (Brit. Mus.)	240
252	*Red Sea 6*			Klunzinger's Korallthiere, ii. pl. vii. fig. 4, pl. v. fig. 29.	Stuttgart Mus.	241
253	*Red Sea 7*, near Koseir			Klunzinger's Korallthiere, ii. pl. v. fig. 18.	Berlin Mus.	241
254	*Red Sea 8*			? Klunzinger's Korallthiere, ii. pl. v. fig. 20.	Paris Mus.	241
255	*Red Sea 9*			Klunzinger's Korallthiere, ii. pl. v. fig. 27.	Berlin Mus.	243
256	*Egypt*, Wadi Ramlieh, Arabian Desert of Middle Egypt.			Zeits. Deutsch. Geol. Gesell. xxxvi. (1884) pl. v. fig. 6.	? Cairo Mus.	246

TABLE II.—SURVEY OF THE GEOGRAPHICAL AND GEOLOGICAL DISTRIBUTION OF THE GENUS AS ABOVE DESCRIBED AND RECORDED.

	District.	Horizon.	Fossil.	Recent.	Total.
Polynesia	Society Islands			3	3
	Union Islands			1	1
	Samoa	(with six records	without descriptions)	1 (+ 6)	7
	Tonga Islands			10	10
	Fiji Islands			24	24
	Ellice Islands	(with seven records	without descriptions)	17 (+ 7)	24
	New Hebrides			1	1
	Queen Charlotte Islands			1	1
	Solomon Islands			10	10
	New Ireland			1	1
	New Guinea			3	3
	Pellew Islands	(with two records	without descriptions)	1 (+ 2)	3
	Caroline Islands	(with one record	without description)	4 (+ 1)	5
	Laysan			3	3
	Sandwich Islands			9	9
	Gulf of California			3	3
	Bay of Panama			1	1
Australia	Great Barrier Reef			42	42
	North-East Australia			2	2
	North Australia			8	8
	North-West Australia			8	8
Malayan Region	Timorlaut			1	1
	Banda Sea			2	2
	Moluccas			1	1
	China Sea			19	19
	Philippines			6	6
	Mergui Archipelago	(Four records	without descriptions)	.. (4)	4
	Java Sea	Tertiary	1	1	2
Indian Ocean	Christmas Island	Pleistocene	3	1	4
	Kokos Islands			1	1
	Ceylon and Gulf of Manaar		(sub-fossil) 2	20	22
	Maldives			3	3
	Diego Garcia			3	3
	Rodriguez			2	2
	Mauritius			5	5
	Seychelles			1	1
	Amirantes			3	3
	Providence Island			2	2
	Madagascar			1	1
	Zanzibar			1	1
	Dar-es-Salaam			1	1
	Cape of Good Hope			1	1
India and Persia	Sind (fossil)	Eocene	1	..	1
	Persia (Lake Urmi)	Miocene	1	..	1
	Persian Gulf			2	2
Red Sea and Egypt	Red Sea			9	9
	Egypt	Tertiary	1	.	1
					268

The paucity of the fossil representatives of a form now so widely distributed is a striking feature of this list. What fossil forms are known come from Christmas Island (Pleistocene), Java ("Tertiary"), Sind (Eocene), Persia (Miocene), and Egypt ("Tertiary"), show a fairly wide distribution, and in India a considerable age. These facts would lead us to the conclusion that closer research alone is wanting in order to bring an extended fossil *Porites* fauna to light, at least in Tertiary formations.

Table III.—A SURVEY OF THE DISTRIBUTION OF THE DEFINABLE GROWTH-FORMS.

[N.B.—References to the figures illustrating the specimens mentioned in the following lists will be found in Table I.]

As in the corresponding Table in Vol. IV., p. 169, we again assume that the form of the initial colony of *Porites* was a small plano-convex disc, and that from it all subsequent growth-forms start. We may add, also, that the introductory remarks there made are equally applicable to this genus also. A brief discussion on the taxonomic value of the growth-form in so variable an organism as a coral colony will be found in the observations at the end of this Table.

A. *Plano-convex.*

This ideal primitive form does not seem to persist as a growth-form, at least without considerable modification, in *Porites*. In the more rigid *Goniopora* it occurs somewhat frequently, see Vol. IV. I have, however, put under this heading all those forms with expanding creeping edges and with gradual thickening of the central regions, which central regions remain more or less smoothly convex. However high these centres grow there is always this difference between such stocks and the globular form, inasmuch as the central region of the latter rises rapidly and swells so as to overhang the edges, which early cease to show any lateral growth.

P. Tonga Islands 3. Creeping irregularly over dead coral.
P. Fiji Islands 20. Rises into a steep mound.
P. Laysan 2. Convex, but with uneven surface.
P. Bay of Panama 1. With very irregular marginal outline.
P. Great Barrier Reef 22. Centre rises rather steeply to a mound.
P. Ceylon 10 and 11. On the shell of the pearl oyster.
P. Diego Garcia 1. With edges closely adherent, even bending under.
P. Egypt 1. Expanded, convex.

Doubtful:—

P. Ellice Islands 15.
P. Great Barrier Reef 32. } Perhaps young stages of globular forms.
P. Solomon Islands 2. A fragment.

B. *Explanate.*

These forms arise from primitive plano-convex colonies by early cessation of growth in thickness with rapid extension of the margin, the budding being confined to the polyps round the edges of the epitheca. They may be:—

a. Purely encrusting, that is, without free edges.
b. With free edges.

a. Purely encrusting, that is, without free edges. With reference to these it must be remembered that if small they may be only young stages of some of the more specialised stocks, and if large they may still rise up at any point into branchings or lobes, either spontaneously or where specially stimulated by the environment—and would then belong to division C.

P. Fiji Islands 3.
P. Fiji Islands 23.
P. Ellice Islands 2.
P. China Sea 6.
P. China Sea 7.

Doubtful forms.—In addition to the uncertainties mentioned above, another frequent cause of doubt lies in the fact that it is not always easy to say whether what appears to be an encrusting expanding colony is not in reality merely a patch surviving on the top of a dying massive form.

P. Tonga Islands 2. As a small cap on a solid mass.
P. Fiji Islands 18. May be a young stage.
P. Sandwich Islands 8. Seems to envelop small objects; repeated layers build up rounded nodules.
P. North-West Australia 1. Appears as a loose crust, but may be a massive form with a boring sponge continually destroying the coral just below the living layer.
P. Moluccas 1.
P. Philippines 5. An irregular conical mass. (See list E, *c*.)
P. China Sea 11. May build up massive forms. (See list E, *c*.)
P. China Sea 15. A massive lobate ridge. (See list E, *c*.)

b. Explanate, with edges growing out freely from some central or lateral attachment, and supported by epitheca.

P. Ellice Islands 1. Very thin.
P. Fiji Islands 16. With edges turning up.
P. Laysan 3. With edges turning up, surface smooth.
P. Sandwich Islands 6. The whole stock crumpled, surface consequently uneven.
P. Great Barrier Reef 1. A fragment; surface smooth, wavy, lobate, edges turning up.
P. Philippines 6. Carried on the back of a Gastropod. Surface smooth.
P. China Sea 3. Very thin, with surface uneven owing to the presence of round-topped cœnenchymatous papillæ.
P. China Sea 4. A flat disc, with smooth surface.
P. China Sea 5. A fragment, with uneven surface.
P. China Sea 13. Surface warty, owing to the bulging up of small groups of calicles.
P. China Sea 14. Appears to be a young stage with free edges; large massive stocks occur, apparently built up by close incrustations of this same coral.
P. Mauritius 1. Thin, wavy; attached by central stalk.

P. Amirantes 1. A thin disc, with surface smooth.
P. Red Sea 6. The surface is raised into cœnenchymatous ridges.
P. Red Sea 7. Probably a young stage.

The remarkable projecting discs or tongues formed by the creeping edges of the branching forms, *P. North-West Australia 4*, and *P. China Sea 10*, deserve mention. In all cases the Bryozoa which coat the under surfaces of the discs, seem to have had something to do with their production.*

C. *Cluster Formation of mounds, mammillæ, lobes, ridges, columns, and even branching stems, rising irregularly from explanate surfaces.*

This combination of explanate with cluster formations is placed here because the explanate growth is common to them all. It represents their first stages of growth, not merely during a short initial period but for a considerable time, and is a feature of the ultimate growth-form. In these forms it is always possible for explanate outgrowths to start anywhere from the sides of one of the up-growths and produce a new horizontal explanate base for fresh cluster formation.

These growth-forms may be divided into two :—

a. The explanate surface continues to expand horizontally.
b. The explanate portion of the stock hangs or creeps down round the base of the cluster, as the latter continues to rise and to thicken.

a. With wide persistent explanate bases. These clusters of columns, lobes, etc., differ from true columnar forms in the fact that they do not rise from small initial colonies directly as single up-growths, but spring up in close or scattered groups from the surface of already expanding stocks. The expanding portion is always a part of the growth-form.

P. Fiji Islands 5. Surface rendered uneven by cœnenchymatous swellings.
P. Fiji Islands 6. A fragment only ; surface smooth, with rounded elevations.
P. Fiji Islands 17. "Mammillæ and tubers."
P. Fiji Islands 19. Crumpled into mounds.
P. P. Fiji Islands 24. Mammillæ.
P. Sandwich Islands 7. Tall stout ridges.
P. Gulf of California 2. "Ridges, lobes and branches."
P. Great Barrier Reef 6. Mammillæ, with older clusters in next group, *b*.
P. Great Barrier Reef 19. Perhaps belongs to next group, *b*.
P. Great Barrier Reef 26. Occurs with an older cluster, mentioned in next group, *b*.
P. Great Barrier Reef 27. Small stalked knobs.
P. Great Barrier Reef 28. May produce single large stalked knob.
P. North Australia 3. With cœnenchymatous spikes.

* These Bryozoa have been submitted to Mr. Kirkpatrick ; they are all of cosmopolitan genera. On the China Sea specimens they appear to be *Cribrilina radiata* and *Microporella ciliata* ; on the Australian coral, a *Cellepora* encrusts the under surface of the disc.

P. North Australia 6. With knobs and submoniliform branches.
P. North-West Australia 6.
P. North-West Australia 8. Occurs with an older form belonging to next group *b*.
P. Java Sea 2. Long spikes, rising from explanate base, and often branching.
P. Philippines 4. Irregularly tuberous.
P. Singapore 5. Tall columns, flattened and spatulate at the tips.
P. Mauritius 4. Tall columns, rounded, and slightly moniliform.
P. Ceylon 12. Mammillæ.

b. Cluster formations without expanding bases. These may either be older stocks of the last section, *a*, or new growths. New growth periods of *a* will mostly start from the tops of their first-formed clusters, and, beginning to envelop them, will have their centres already raised for the formation of more towering clusters, from which, in some cases at least, the explanate basal portions will droop downwards. The resulting stocks are large clusters swelling out above irregular stalks, round which creeping edges depend. But the same result would also be obtained if such a colony *started* not from a previous growth but from a raised point of an inorganic substratum. As a rule in cluster-formations the remains of earlier smaller clusters can be traced in fractures through the base. In *P. Great Barrier Reef 24*, the whole process can be traced in a single specimen. It began as an encrusting colony with mammillate centre. The explanate encrusting layer increased up to a certain size, but with a comparatively much larger central cluster after each growth period. The living layer ultimately merely swelled the cluster, no longer even reaching down to the old explanate pedestal of the stock. This phenomenon is sometimes seen by comparing specimens of the same coral at different ages, e.g. in *P. Great Barrier Reef 6* and *26*. In such cases, where two specimens show the two stages, the younger stages are mentioned under C, *a*, and the other in the list now following.

P. Ellice Islands 3. The specimens show traces of—(1) a smooth explanate stage; (2) a mound of round lobes; (3) a mulberry shape; and lastly (4) a tall conical mass of similar lobes.
P. Solomon Islands 4. A tangle of thin cœnenchymatous processes.
P. Caroline Islands 4. A very irregular mulberry-shaped mass.
P. Great Barrier Reef 15. A swelling mass of irregular tuberosities.
P. Great Barrier Reef 17. A cluster of irregular mammillæ or digitform processes.
P. Great Barrier Reef 24. Shows the process described in the note above.
P. Great Barrier Reef 26. Large dense cluster of stout lobes. A younger stage mentioned in list C, *a*.
P. Great Barrier Reef 41. Cluster of small ridges, which divide up irregularly.
P. Great Barrier Reef 42. Small clusters of mammillæ, which radiate outwards in all directions from centres.
P. North-West Australia 2. A mound of short thick irregular knobs.
P. North-West Australia 6. Irregular lobate ridges.
P. Singapore 3. Rises into tall clusters of processes, often flat columns with dividing tops.
P. Singapore 4. A cluster of very short knobs from which thin digitform processes rise, the cluster apparently branching.
P. Ceylon 13. A small mulberry-shaped mass.

D. *Cœnenchymatous Forms.*

The growth-forms of the group are difficult to define. Roughly speaking, it includes all those forms the walls of which are sufficiently well developed as to be able to rise irregularly into papillæ. These papillae run together to form ridges and ramparts round individual calicles. A provisional definition—to be tested by further research—may be suggested. The cœnenchymatous forms are those in which the calicles are so unevenly distributed that, between at least a large proportion of them, the walls are thick enough to show several intervening costal trabeculæ (cf. Introduction, p. 15). Such thickened walls may or may not rise up into mounds or papillæ. For further details see Table IV.

Encrusting forms:—

P. Fiji Islands 5. With crumpled surface and irregular ramparts.

P. China Sea 3. Thin, freely expanding, with rounded papillæ.

P. China Sea 12. Encrusting, with smooth, low, conical ridges, usually wider than walls, and carrying calicles.

P. Amirantes 1. Thin, explanate, with the wide walls smooth and flat.

P. Red Sea 6. Encrusting, with smooth, conical mounds.

Doubtful forms:—

P. Ellice Islands 2. It is not clear whether the proliferation of the walls may not be due to the presence of worm-tubes.

Encrusting forms, which in older stages seem to lose the explanate base and tower up in masses, columns, or branching processes:—

P. Society Islands 2. Dense clusters of tall, thin, flattened stems; sharp wall-ridges, with ragged edges.

P. Society Islands 3. Thick clusters of very rough, angular, flame-like processes.

P. Fiji Islands 9. A cluster of angular stems; calicles scattered.

P. Fiji Islands 14. Rough columns. Cf. original figure (see Table III.).

P. Fiji Islands 15. Rough columnar mass. Cf. original figure (see Table III.).

P. Solomon Islands 4. Coxcomb-like processes, with long intervening mounds on the walls.

P. Caroline Islands 3. Rises into towering columns; cœnenchymatous ridges, often wider than walls, and with calicles opening on them.

P. Great Barrier Reef 9. Erect columns; tall, cœnenchymatous ridges intervening.

P. Great Barrier Reef 10. Erect, irregular fluted columns; ridges wider than walls, and carrying calicles.

P. Phillppines 2. Rough, columnar mass. Cf. Dana's original figure.

P. Ceylon 19. "Like *P. Society Islands 3.*"

P. Red Sea 4. "Erect lobes or columns."

Branching:—

P. North Australia 4. Erect stem, with spreading branches; compact rampart formation.

P. China Sea 10. A tangle of stems, with circular ramparts.

Doubtful:—

P. New Guinea 1. Large masses of stout cylindrical branches.

P. Sandwich Islands 4. Consists of uneven, angular, and crowded branches.

Forms with roughened surface, very suggestive of the true cœnenchymatous *Porites*, are produced by excessive crowding of the calicles. Small groups rise up into rough, wart-like eminences—e.g., *P. Fiji Islands 24, P. China Sea 13, P. Mauritius 5*; in the last case even leading to nodulated branches. All such must be distinguished from true cœnenchymatous forms, which are not due to any overcrowding, but on the contrary to a scattering of the calicles, with a large amount of intervening tissue.

E. *Massive and Glomerate.*

These forms are to be regarded as due to the growth of the initial plano-convex colony more rapidly in the central regions than round the edges. It is obvious that, according to the relative rapidity of growth of the two, we may get—(1) thick flat cakes; (2) globes; (3) tall ovals and columns (the expanding sheaf formation); and (4) thin stems, which are the starting-point for branching and dendriform stocks.

In nature, of course, this ideal series is much interfered with by all the chance variations of the environment, and it is often difficult to attribute individual specimens to any definite kind of growth, especially as the same shape of stock may in some cases be attained, as it were, accidentally along different lines of growth.

a. Thick expanding cakes:—

(i.) With nearly perpendicular, or only slightly bulging sides.

P. Great Barrier Reef 7. A boring sponge may have influenced this growth.

P. Great Barrier Reef 30. With level top and lobate outline.

P. Cape of Good Hope 1. Smooth top, but very irregular outline.

(ii.) With sides, where growth is rapid, projecting far over the substratum, but with flat, wavy top. Cf. the diagram Pl. XIII. fig. 8.

P. Fiji Islands 4. With roughened top surface.

P. Fiji Islands 7. Thick, with rounded edge.

P. Fiji Islands 22. With very smooth edge; here sharp, there rounded.

P. Ellice Islands 5. Thin, with sharp edge.

P. Ellice Islands 6. Edge sharp and wavy.

P. Ellice Islands 8. May also belong to E, *b*.

P. Ellice Islands 9. A complete stock; sides here steep, there sharply projecting.

P. Ellice Islands 10 ?

This (ii.) seems to be a definite type of growth-form, and may be compared to an expanding sheaf formation, in which the centre ceases to grow, and only the lateral parts, which bend outwards all round, continue the growth of the coral.

b. Globular forms:—

(i.) With smooth, or only slightly indented surface, continuing to grow, unless accidentally distorted, as single rounded stocks.

P. Tonga Islands 7. A quarter of a globe, with slightly wavy surface.

P. Ellice Islands 7. Fragment, with smooth surface, as if chipped off a rounded mass.

P. Ellice Islands 12. With irregular, long, oval outline, and smooth surface.
P. Queen Charlotte Islands 1. A smooth, stalked, rounded mass.
P. Solomon Islands 1. A knob, with slightly indented surface.
P. Solomon Islands 5. Smooth, slightly wavy surface.
P. New Ireland 1. Nearly hemispherical, with smooth surface.
P. Laysan 1. Nearly regularly rounded, but with flattened base.
P. Great Barrier Reef 14. Rolls over, but the fresh growth always rises as a smooth knob.
P. Great Barrier Reef 20. Egg-shaped, with slightly wavy surface, attached by its blunt end to seaweed.
P. Great Barrier Reef 29. No matter how grown, always resulting in smooth, rounded knobs.
P. Great Barrier Reef 31. Typical, the stock appears once to have died down, and to have been re-encrusted by a new layer.
P. Great Barrier Reef 34. Slightly oval in outline, otherwise typical.
P. North-East Australia 1. Irregularly globular, quite smooth.
P. North-West Australia 3. Oval outline, and slightly flat-topped.
P. North-West Australia 7. Stalk and interior destroyed (? by boring sponge).
P. Philippines 3. Irregular oval, with smooth top.
P. China Sea 1. Globose, with narrow stalk, surface uneven.
P. China Sea 17. Very smooth, inclined to taper at the top above the bulging sides.
P. Ceylon 6. A perfectly smooth, oval mass, formed upon dead coral.
P. Diego Garcia 2. Overturned, but rising again as a smooth, rounded knob.
P. Rodriguez 1. Smooth, round, slightly flattened on the top.
P. Rodriguez 2. Though rolled over, rises as a round knob, slightly flattened on the top, and with wavy sides.

Doubtful:—
P. Great Barrier Reef 13. A fragment.
P. China Sea 2. "Glomerate."
P. Ellice Islands 8. Smooth and rounded, but apparently influenced by a boring sponge. May also belong to E, *a*.
P. Mauritius 2. Smooth, but distorted by the Gastropod *Magilus*.

(ii.) Globular with convoluted surfaces.
If the convolutions are pronounced and appear early, the older stocks may cease to be rounded, and become irregular lobulated or reniform masses.
P. Fiji Islands 2. An old reniform mass, repeating in each of its lobules the form of the young stock.
P. Ellice Islands 11. Convolutions marked, but shallow and wide.
P. Ellice Islands 13. } Fragments, both showing wavy surfaces, with rest of the
P. Ellice Islands 14. } growth distorted.
P. Solomon Islands 6. A deeply convoluted mass, incorporating branches of a *Madrepora*.
P. Great Barrier Reef 8. Flattened top, showing signs of cross valley formation.
P. Great Barrier Reef 23. Two fragments of a large, deeply convoluted stock.
P. Great Barrier Reef 33. Small, no old stock known.

P. North-West Australia 4. An oval mass, appearing to divide into lobes by cross valleys.

P. Ceylon 1. A large, flat, reniform mass, with low symmetrical lobules.

P. Ceylon 4. A convoluted stalked mass, which seems to have begun as a pear-shaped column. See also F.

P. Ceylon 7. A large, deeply convoluted, spherical mass, supported on branches of *Madrepora*.

P. Ceylon 18. The top convoluted surface of a globular (?) mass, sawn off.

P. Red Sea 1.

Here may be added the mulberry-shaped masses. There are four such stocks, swollen round their bases and then rising into a sub-conical mass, covered with small lobes or swellings nearly uniform in size and shape for each form.

P. Ellice Islands 3. } These two might perhaps be referred to section C, *b*. They
P. New Hebrides 1. } are both accompanied by younger stocks, which suggest encrusting habits.

P. Ceylon 13. } The most interesting feature of these two is the fact that each
P. Singapore 2. } separate lobe appears to be due to the expanding sheaf formation. In *P. Singapore 2* the calicles at the top of each lobe open in a streaming lamellate network.

c. Massive forms, not attributable to any clearly defined principle of growth (see observations below on the "amorphous" forms):—

P. Ceylon 1–9. The forms presented by this series enable us to conclude that the original stocks settled upon some dead remains of other coral, and after a time fell over, and, in so doing, supplied more or less precarious foundations for their later developments. In no case did a specimen succeed in attaching itself again to the substratum. However large, it is always perched upon a central support, consisting of dead overturned previous stocks. In one case only (*P. Ceylon 4*) can the original stock be traced to a pear-shaped column. Such a form is also seen in one of the smaller specimens of this coral, and, what is most interesting, the lobes which characterise the largest stock all repeat the shape more or less closely. In other cases we can see somewhat the same surface specialisation in both the larger stock and smaller dead supporting stocks. But, except in the one case mentioned, we have hardly enough evidence to be able to reconstruct the original modification of the colony from the surface specialisations of the stocks themselves.

P. Singapore 1. This form also seems to have early fallen over, and to have expanded laterally, with thick rounded edges, above the substratum, perched upon the dead former growths. As the central regions rise in height, they seem to send out tier after tier of these thick edges rolling down one over the other.

P. Persian Gulf 1. A series of forms which seem to owe their present shapes to the accidents of deposition of sediment. If we may assume that the specimens most broken up into crooked distorted columns are those on which most sediment fell, then those least broken up may have represented the natural growth of the stock, viz. massive, rounded, with tall, ridge-like convolutions.

P. Great Barrier Reef 36. A fragment of some form apparently built of irregular nodulated ridges.

P. Great Barrier Reef 37. A fragment showing quite an unusual growth-form—a thick erect leaf, with wavy uneven lateral surfaces, an incipient lobe formation on the lateral edges, while the top edge tends to split longitudinally into two leaves or rows of lobes.

P. Philippines 5. } May be due to the regular thickening of encrusting
P. China Sea 11 and *15.* } colonies.

P. Singapore 6. Is a cluster of thinner, shorter ridges, with the same tendency to longitudinal splitting as described for the last form.

P. Red Sea 2. Massive, convex, and humpy.

P. Sandwich Islands 7. Massive, uneven, with rounded or oval knobs.

P. Ceylon 5. With prominent, rounded lobes.

P. Christmas Islands 1–4. Massive, of unknown shape.

F. *Oval or Pear-shaped, and Columnar.*

These include forms which assume the above-mentioned shapes by the expanding-sheaf method of growth.

i. Oval and pear-shaped :—

P. Society Islands 1. As lobate knobs from lateral attachment.

P. Tonga Islands 4. As a pear-shaped knob enveloping a branch of a *Madrepora*, surface indented.

P. New Guinea 2. As smooth, pear-shaped knobs on branch of coral.

P. Banda Sea 1. A lobate mass, attached laterally.

P. Timorlaut 1. A mass, attached laterally, and swelling horizontally.

Cf. also *P. Great Barrier Reef 20.* An egg-shaped mass attached to seaweed.

ii. Columnar :—

P. Tonga Islands 5. } As a swelling column, from small base, and tending to divide
P. Tonga Islands 6. } unequally.

P. Fiji Islands 12. Stout, flat-topped column, with smooth sides.

P. Solomon Islands 7. Round-topped, double columns of unequal size, divided down to the base.

P. Solomon Islands 8. Flat-topped, double columns, divided unequally on one side only down to the base.

P. Sandwich Islands 3. Cluster of smooth columns, fused, but with tops as rounded lobes.

P. Great Barrier Reef 2. Columnar mass, fluted, tops of flutings separated for short distances.

P. Great Barrier Reef 25. Tall, slender column, with cluster of similar columns springing from flattened top.

P. Great Barrier Reef 35. Apparently the top of a stout, irregularly lobate column.

P. China Sea 16. Irregularly fluted mass, with slight divisions at the top.

P. Ceylon 4. Appears as a single column in early stage ; old stocks may be a mass of lobes, each lobe suggesting in its form a repetition of the original single column.

P. Maldives 1. A short round-topped mass, as if dividing vertically into unequal, columniform lobes.

P. Red Sea 5. Nearly always columnar, sometimes mounds or tubers.

Irregular column formation due to other growth methods:—

P. Fiji Islands 14. Cf. Section D.

P. Fiji Islands 15. Cf. Section D.

P. Singapore 3. Cf. Section C, *b*.

P. Singapore 5. Cf. Section C, *a*.

P. Mauritius 4. Cf. Section C, *a*.

P. Persian Gulf 1. Cf. Section E, *c*.

P. Caroline Islands 3. Cf. Section D.

P. Great Barrier Reef 9. Cf. Section D.

P. Great Barrier Reef 10. Cf. Section D.

P. Ceylon 8. Cf. Section E, *c*.

G. *Branching Forms.*

The forms it is intended to include under this heading are those which start by the direct uprising of the central part of the initial plano-convex stage, without any further lateral expansion of that stage. Inasmuch, however, as most branching specimens have been broken off somewhere above their bases, it is not possible to know exactly how they started. Section C is a list of clusters, lobate and branching, the origin of which from expanding bases can be gathered from the specimens themselves. The more purely branching clusters will be given again here.

It is not easy to divide the different kinds of branchings, accident of position has doubtless much to do with it. One character, however, seems to be fairly trustworthy, viz. the shape of the stems and branches. Some are cylindrical, the stems and branches remaining cylindrical throughout with the succession of forkings taking place in different planes. In others the tendency is to flatten and to divide repeatedly in the same plane, so as to give rise to flabellate, palmate, or cockscomb-like leaves, the edges of which break up into branchlets.

a. With cylindrical or only slightly flattened stems forking in all planes:—

(*Note.*—In order to strengthen the stems the horizontal layers of the calicle skeleton are often specially developed, and show in the calicles as flakes, more or less affecting the septa. All those in which these flakes are conspicuous in the calicle are marked with an α; all those in which the flakiness is disguised by tall, stout trabeculæ, rising to form a granular, or sometimes a smooth velvety surface, are marked β; cases unmarked are either exceptions or else there is no information available. See further below p. 270 in the observations.)

P. Union Islands 1. See text, p. 32.

P. Samoa 1. Thin stems, with scattered nipple-like twigs.

α *P. Tonga Islands 8.* Tall, thin, dendiform.

P. Tonga Islands 9. Clumps of short and curving branches.

α *P. Tonga Islands 10.* Erect, with slight angular bends (for possible early stage, see text, p. 41).

α *P. Fiji Islands 1.* Erect stems, with alternate swellings and constrictions.

α *P. Fiji Islands 8.* Long, erect, wavy stems.

β *P. Ellice Islands 16.* A fragment, branches compressed and distorted.
β *P. Solomon Islands 3.* Short, thin, delicate tips, flattening and forking.
β *P. Solomon Islands 9.* Stout stems, with thin, tapering, curving branches.
P. New Guinea 1. Branches and branchlets cylindrical, tips seldom flattening.
P. Pelew Islands 1. Like branching goat or antelope horns.
P. Caroline Islands 1. Dense dichotomously branching clusters, branchlets all reaching to about the same height.
P. Caroline Islands 2. Stems fusing irregularly, submoniliform, with globular twigs.
P. Sandwich Islands 1. Branches stout, compressed, erect.
P. Sandwich Islands 5. Dividing dichotomously, with short, stout, flat-topped branchlets.
P. Gulf of California 3. Branches low, crowded, fusing, cylindrical.
β *P. Great Barrier Reef 12.* Stems faintly constricted, stout, and very smooth, branchlets thin, curving and flattening at tips.
P. North Australia 1. Tops swell and divide into flat-topped irregular knobs. (Cf. Section C.)
a P. North Australia 4. Erect, rough, angular stem, breaking up into rough, curved, divergent branches.
P. North Australia 5. Single, stout, smooth stem, forking and tapering into points like a bird's claw.
P. North Australia 7. Thin, dichotomously branching, here cylindrical, there somewhat compressed.
a P. North Australia 8. Short, thick, smooth stem, with long, thin, bent and tapering branches scattered over it.
P. Banda Sea 2. Branchlets thin, compressed and forking at small angles.
a P. Java Sea 2. Long, thin, tapering spikes, sparsely branching. See also Section C, *a*.
? *a P. Philippines 2.* Short stem, breaking into small clusters of short, thick, outwardly curving points.
β *P. China Sea 9.* A close tangle* of stout nodulated, bent branches, freely fusing together.
P. China Sea 10. Tangles* of rough, fusing, angular stems, mostly very thin, with explanate outgrowths. See text, p. 173.
a P. China Sea 18. Tangles* of stout cylindrical stems, with tapering round-tipped branchlets.
a P. Singapore 7. Rounded stems and branchlets, forking at wide angles and freely fusing together.
a P. Kokos Islands 1. Branchlets flatten and divide rapidly into nipple-shaped tips.
β *P. Maldives 3.* Rounded branches and branchlets, forking at wide angles and freely fusing (occurs in large, free, lenticular masses).
P. Mauritius 5. Also free. Supported by nodulated branches and branchlets, radiating outwards in all directions.
P. Amirantes 2. Irregular in thickness and manner of forking. Branchlets often as thin, tapering, bent spurs.
P. Dar-es-Salaam 1. Branching from the ground, growing among "sea grass."

* Tangles are mostly the débris of generations of broken down and overturned stocks which new growths bind together. Only the general characters of the stems can be made out.

b. Stems either flattened, and, for other reasons, fusing into flabellate, palmate, or cockscomb-like clusters :—

(*Note.*—Fusions of stems naturally make for mutual support.)

P. Society Islands 2. May appear as clusters of thin, flat, narrow leaves, with rounded tops.

P. Solomon Islands 4. See Sections C, *a* and D.

P. Great Barrier Reef 3. Irregular flabellate arrangement of strings of knobs.

P. Great Barrier Reef 4. Very irregular flabellate plates, breaking up into rough lobulation and crumpling up the edges.

a P. Great Barrier Reef 11. Thin, straight, flattened branches and flabellate plates.

? *P. Great Barrier Reef 18.* Short, stout cluster of stems and branchlets, with traces of flabellate arrangement.

P. North Australia 2. Short, stout cluster of thick stems, tips flattened, and giving rise to flabellate up-growths.

P. Philippines 1. Stout stems, with sudden palmate arrangement of branches.

P. China Sea 19. Stems very stout and rapidly tapering—tend to fuse into palmate groups.

P. Singapore 5. Columns or branchings, with broad spatulate tips. See section C.

P. Maldives 2. Clusters of long, thin, gradually flattening stems, the tips often irregularly flabellate or cockscomb-like, dividing into small angular branchlets or knobs.

P. Diego Garcia 3. Clusters of stout, palmate arrangements of cylindrical or flattened branches and branchlets.

P. Seychelles 1. In clusters of flabellate branches, the tips forking fishtail-like.

P. Mauritius 3. Clusters of tall, thin, flattening branches, dividing at the tips into long, thin, somewhat angular branchlets.

c. Irregular branching forms, which cannot be specified under either of the above headings :—

P. Ellice Islands 4. A fragment, which is a detached, warty knob, as if beginning to fork.

P. Ellice Islands 17. Fragments ; two spatulate up-growths.

P. North Australia 6. Rises into branching strings of rounded or oval knobs.

P. North-West Australia 5. A fragment ; a curving, tongue-shaped outgrowth, apparently branching.

P. Amirantes 3. A free, central stem, from which nodulated branches radiate in all directions and support the stock.

P. Providence Island 1. Also a free, central mass, supported on shorter, stouter processes.

P. Providence Island 2. Irregular knobs, from which the irregularly bent and branching processes grow out.

In addition to these, the flame-like clusters of the cœnenchymatous *Porites* might be included. See Section D.

Observations on the Taxonomic Value of the Growth-Forms in Porites, and on the Relationship between Growth-Form and Calicle Structure.

There is a natural tendency, in the presence of so much variability, to assume that the growth-form is for all practical purposes a factor of the environment alone. This is, however, only occasionally the fact. There is abundance of evidence to show that each kind of *Porites* has its own principle of growth, which, in a neutral or unchanging environment, would always repeat itself. In *Montipora* it is known, for instance, that small areas of the sea bottom may be covered with some strange but constant form.* Then, again, forms of *Porites* which are accidentally overturned mostly show a tendency to repeat the same shape of stock upon the prostrate previous growth. Further, branches or columns, which spring up from one and the same explanate growth, all have the same character. All these show that there is a principle of growth belonging to each different kind of calicle. But, as against this, we recall the evidences already given of the power of the environment to reduce specimens of different kinds of corals, not only of one and the same genus, but even of different genera, to the same forms. Compare the facts, that from the Amirantes we have *Montiporæ* and *Porites* found side by side, so alike that only an expert can distinguish them,† and again in the China Sea we have *Porites* and *Gonioporæ* showing in the same locality the same remarkable specialisations of the calicle skeleton.‡

Every specimen, then, which we examine has to be looked at as the result of these two factors. Guessing as to which has played the chief part in its production is useless; we have only the path of patient research before us. The lists given above, which are necessarily provisional, are to be regarded as an attempt at a systematic arrangement of the data, to be corrected and added to as new facts come to light.

We may, indeed, at once gather from these lists that while in some forms the growth natural to them in a neutral environment will be very difficult to find out, owing to the excessive plasticity of the colony, a number of forms (e.g. *P. Ceylon 4*) will be found, the growths of which show a marked tendency to repeat certain form-features. We may hope, therefore, that in time we shall be able to discover in such forms some correlation between calicle and growth-form.

We may call attention to the following cases. In branching forms there is a tendency in the interests of strength to thicken the horizontal (or in the section of a stem the concentric) layers of the calicle skeleton. The thickening may take place high up in the skeleton, making all the skeletal elements at the surface more or less flaky (see the cases marked α in list G, a, above). It may take place at varying depths of the calicle, consequently allowing the trabeculæ to appear at the surface as the most conspicuous elements (see cases marked β in the same list). Lastly, the whole of the skeleton may be equally thickened. The cases of *P. Tonga Islands 8* and *9* are interesting; they are clearly related, but in the former the stems

* Cf. "The Naturalist in Australia," by W. Saville-Kent, 1897, p. 146.

† See *P. Amirantes 3*, p. 225.

‡ See *P. China Sea 4*, p. 168.

are long and the horizontal layer is thickened, in No. 9 the stems are very short and there is no abnormal thickening whatever.

As an illustration of another kind, take the calicles shown on figs. 8 and 9, on Pl. XXVIII. The former are of the remarkable cluster of tall, tapering spikes from the Java Sea (No. 2); the latter, with thin, minute, insignificant ragged skeletons, are of the Christmas Islands (No. 1), with reference to which Dr. Andrews informs me that it appeared to be quite amorphous, forming patches of no definite shapes all over the reef. At the first glance at the figures we seem to understand how such calicles might be referable to such growth-forms; but the *reasons* have to be discussed, and that will only be when we have many such cases at our disposal for comparison.

Need I again enforce the argument that, in the presence of these uncertainties as to the taxonomic value of the principal characters of growth-form and calicle structure, and of our ignorance as to how far variations in the one influence variations in the other, all attempts at a specific classification are premature? The only natural classification at present possible is a tabulation of the ascertainable facts.

A comparison of the branching forms of the West Indies where they appear to be in a great majority and strikingly uniform, with those of this Indo-Pacific area, which our lists show to be in a decided minority and very variable, can hardly fail to be of great interest. At present we have no information as to the causes of this contrast in the relative proportions of the two kinds in the two regions. On the lists above given we may call attention to the relatively large number of branching forms from North Australia and to their absence from the Great Barrier Reef.

Table IV.—ANALYSIS AND DISTRIBUTION OF THE MORE EASILY DEFINABLE TYPES OF CALICLES.

In the Morphological section of the Introduction (p. 12) there will be found an analysis of the fundamental structure of the calicle of *Porites*. This was essential before we could obtain any insight into the real nature of the innumerable variations which the genus presents. Each separate variation is due to some special development or abortion of one or more of the structural elements.

In the following analysis we shall have to confine ourselves to the more important of these variations, viz., to the structure of the walls. Other variations are here regarded as, comparatively speaking, incidental.

We again start from our ideal parent calicle *D*, shown in fig. 4, with its rings of intra-calicular and extra-calicular or costal trabeculæ; regarding the ring marked *w* as the typical *wall* trabeculæ, all on the inner side being intra-, and all outside being extra-calicular. The following tables will chiefly deal with the various compositions of the dividing walls out of these trabeculæ, treating the latter for practical purposes as morphological units. As this seems to be in direct opposition to the principles laid down in 1899* when discussing the "trabecula" of Milne-Edwards and Miss Ogilvie, viz., that it is only so much tissue intervening between the rows of perforations through the septa, and not the all-important morphological unit they assumed it to be, it is well to point out how circumstances may temporarily alter cases. One strand of a tissue more or less makes no difference where there are many, but if there are one, two or three, then one more or less becomes of immediate importance, especially if such variations in amount entail structural variations in other parts of the organism. This is the case with the trabeculæ of *Porites*, in which genus, owing to the small size of the calicles, a single ring of trabeculæ may represent, say, the pali, and thus be of morphological importance. But that this does not in reality bestow importance on the trabeculæ as such we gather from the ease with which even in *Porites* they may all disappear and run together into lamellate plates.

It is necessary therefore for the student to bear in mind that we are dealing in a tentative manner with the phenomena without being at all sure of the morphological importance of the factors with which we are dealing. All we can say is that in the vast majority of cases the trabeculæ seem to fall into the following different arrangements, just as if they were stable elements. For example, as already pointed out in the Introduction, the number of the trabeculæ in the walls of a *Porites* colony should depend upon the width of the calicles apart;

* Journ. Linn. Soc., Zool., xxvii. p. 137.

hence we ought to find extraordinary variation in this respect. That, however, is not the case. The rule is that the composition of the wall is very uniform. We find, for instance, that while in valleys and depressions where the calicles are squeezed together the trabeculæ of the calicular skeleton may be almost indefinitely aborted, on convexities where the calicles have abundance of room it is seldom that more than one extra trabecula appears. If the convexity rises very rapidly the trabeculæ may all disappear as such, and the skeleton becomes a streaming lamellate network.

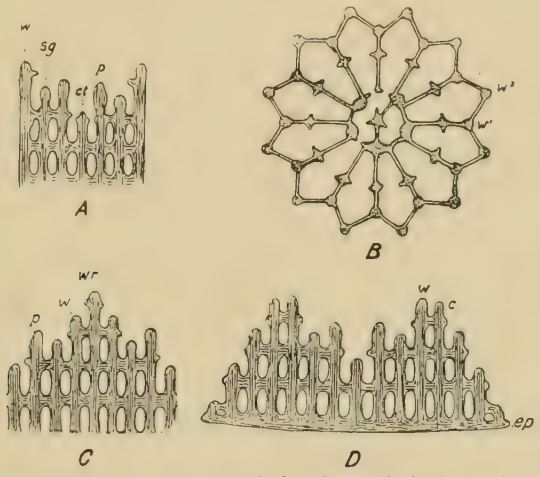

FIG. 4.—Diagrams illustrating the structure of the theca of *Porites*. A, an ideal vertical section through a simple walled calicle of a colony; *w*, the wall trabecula; *sg*, the septal granule; *p*, the palus; *ct*, the central tubercle (these three are seen, like *w*, to be the tips of trabeculæ). B, a horizontal section of a calicle in a colony in which the thecæ are slightly separated so that the synapticulæ joining the wall trabeculæ (w^1) with those of adjacent calicles (w^2) have a zigzag course. C, a vertical section through a compound wall, which appears when the simple walls (*w*) are far enough apart to admit of an intervening trabecula, in this case figured as rising above the walls (*w*) as a wall-ridge (*wr*), making *w* look like another granule of the septal edge (the "wall granule"). D, an ideal parent calicle to explain the origin of intervening trabeculæ; they are homologous with costal trabeculæ (*c*), one or more of which are able to appear if the calicles in a colony are far enough apart to admit them; *ep*, epithecal saucer or prototheca.

We have, then, nothing to do but to go forward and endeavour to arrange those phenomena in the *Porites* calicle which alone seem to admit of tabulation, and those are the variable numbers of trabeculæ which appear in the composition of the walls, and their leading methods of association. The four main divisions are the following:

A. Those in which a varying number of costal trabeculæ *always* play a conspicuous part in wall formation. These are the cœnenchymatous forms of this volume (*Synaræa* of Authors).

B. Those in which one extra trabecula (*wr* in the diagram C) typically—that is, where the calicles are not specially crowded—appears between the wall trabeculæ *w* of adjacent calicles.

C. Those in which the wall trabecula, marked *w* in the diagrams, forms the middle line between adjacent calicles. Those of the one calicle then appear to be arranged alternately with those of its adjoining calicles, as we gather from the fact that the connecting synapticulæ frequently form a zig-zag line. In the Introduction it was assumed that this zig-zag line indicated some interval between the calicles, but it might also indicate the opposite, namely, a crowding as to lead to a kind of interlocking.

D. Those in which the skeleton has melted down into a fluent reticulum, or in other ways become so modified in its texture that trabeculæ are no longer sufficiently pronounced to be of use for either of the previous divisions. All these cases may be regarded as secondary, because vestiges of the trabeculæ can nearly always be made out.

A. *The Cœnenchymatous Forms* (*Synaræa* of Authors).

These cannot form a separate genus, for two reasons: (1) they show no essential structural difference from ordinary *Porites*, the septal and palic formulæ are the same in both, and in the matter of wall formation they intergrade with the rest of the genus; and (2) in this very difference in wall formation they show no single definite plan or method of specialisation of their extra-costal trabeculæ which might entitle them to a separate place. The variations run, as it were, in all directions: they only agree in the fact that they are *Porites* with an irregular number of costal trabeculæ involved in the composition of the wall.

These specialisations may be perhaps divided as follows:

a. With walls of uniform or nearly uniform width.

i. The walls remain smooth over the whole of the level surface.

P. North Australia 1.

P. Amirantes 1. Perhaps a young form.

ii. The walls remain smooth but the surface of the colony rises into smooth, usually angular, ridges and crests.

P. Fiji Islands 9. Colony rises into angular branching processes.

P. Fiji Islands 14. With wall-trabeculæ obscure, appearing at the surface as granules. The horizontal elements somewhat arched.

P. Fiji Islands 15. With pali and wall-trabeculæ pronounced.

P. Great Barrier Reef 10. With pali taller than the wall-trabeculæ (cf. *P. Red Sea 4*).

P. Philippines 2. With pali taller and larger than the wall-trabeculæ (cf. *P. Red Sea 4*).

iii. The walls rise everywhere into inter-calicular ramparts and gyrating ridges.

P. Society Islands 2. The inter-calicular ridges are sharp and ragged edged, with trabeculæ disguised and horizontal elements pronounced and tilted into ragged flakes.

P. Fiji Islands 5 (spec. *a*). With the trabeculæ which form the ramparts, stout, nodulated, and ending as granules. The ramparts are round-topped.

P. Great Barrier Reef 9. With ramparts round-topped.

P. North Australia 4 (spec. *a*). Ramparts thick, smooth and round-topped. Trabeculæ disguised, the horizontal elements arched.

P. North Australia 4 (spec. *b*). Ramparts thin, low, and ragged. Texture of section more open than in spec. *a*.

P. China Sea 9. The ramparts large, smooth and round, as a fluent reticulum.

P. China Sea 10. The ramparts are very small, but the skeletal elements are stout.

b. With walls of unequal width.

i. Walls quite smooth.

? *P. Great Barrier Reef 21.* The wider wall-tops, as patches of smooth delicate filamentous reticulum, nowhere raised.

ii. Walls smooth, but widening here and there; the wider walls rising into excrescences which run together. In the valleys the calicles may be so crowded as to have only single or incomplete walls like those of the more typical *Porites*.

P. Society Islands 3. The colony rises into thin flame-like processes. The wide walls form a fluent reticulum.

P. Caroline Islands 3. The colony rises into tall columns, the wide walls as a delicate fluent reticulum.

P. New Guinea 1. (Said to be like *P. Society Islands 3*, Studer.)

P. Sandwich Islands 4. (Apparently somewhat like *P. Society Islands 3*.)

P. China Sea 12. The wider walls rise into miniature mountain ranges.

P. Red Sea 4. Calicles scattered, visible chiefly from the fact that the pali are taller than the walls. Perhaps this should have been placed in subdivision *a* ii.

P. Red Sea 6. The wider walls rise into miniature mountain ranges.

iii. The walls in level portions of the colony show slight upward bulgings which spring up wherever they widen.

P. Solomon Islands 4. Colony rises into thin, irregular, digitiform processes.

P. China Sea 3. The stock is explanate, with rounded excrescences.

P. North Australia 3. The stock is encrusting, with sudden amorphous excrescences which may tower up into thin branching processes.

iv. The walls rise into inter-calicular ramparts, which run together in patches, forming table-lands with depressions between.

P. Fiji Islands 5 (spec. *c*). The rising walls are of regular open reticulum in which trabeculæ are pronounced.

P. Ellice Islands 2. The rising walls are a delicate streaming reticulum, the trabeculæ of which are thinner than the pali (cf. *P. Philippines 2*).

Observations on these cœnenchymatous forms.—The foregoing analysis now for the first time assigns these forms a place in the morphological series. The variations which they show among themselves are interesting. We note for instance that the additional costal trabeculæ may be fairly uniform in numbers over the whole of a colony, or they may be here numerous, there altogether wanting, on different parts of one and the same colony. Again, they may be as well developed as those in the interior of the calicle (the pali, etc.), or greatly reduced and obscured, the horizontal elements then being pronounced; and lastly together with the horizontal elements, they may form a delicate streaming reticulum, filamentous or flaky, which carries the walls up into papillæ.

On the small size of the calicles seen, with but few exceptions (*e.g.*, *P. Society Islands 2*, *P. Fiji Islands 5*), in these cœnenchymatous forms, compare the observations on Tables B and C, p. 284.

B. *The forms in which one ring of extra, intervening, or costal trabeculæ appears typically in the walls.*

This extra ring of trabeculæ forms the middle line of the walls between adjacent calicles, and within it we have the following typical rings: the wall, the septal, and the palic trabeculæ, represented at the surface by granules. Variations in the development of these seem to be as follows—

a. The extra trabeculæ may rise as a tall, thin, membranous wall, the "wall" trabeculæ proper remaining low. The septal trabeculæ seem to function as the pali, only they are then 12 in number, and the ordinary pali remain aborted, or appear in traces, sometimes as occasional pieces uniting two of the "septal" pali.

b. The extra trabeculæ are not conspicuously the chief constituents of the dividing walls, and the pali are not aborted.

a. The extra trabeculæ seem to function as the wall trabeculæ do in single-walled forms, thus giving an extra ring of trabeculæ to the two usually present within the calicle. If this interpretation is correct it is most remarkable, and represents the largest type of calicle in the genus. From this downwards all the subsequent divisions show progressive diminution, ending in C, *b*, v.

P. Fiji Islands 4. In the text the septal ring of 12 was mistaken for divided pali. The true pali occasionally appear distinct from these "septal" pali.

P. Ellice Islands 5. The true pali are somewhat more frequently developed than in the last form, and then sometimes form a separate inner ring, and sometimes unite the septal granules into V-shaped processes.

P. Ellice Islands 8, *P. Ellice Islands 9* } represent two interesting variations on the above.

P. Ellice Islands 10. This seems to be a variation of the same, but with minute deep calicles, with the wall-, septal, and palic granules very closely packed.

P. China Sea 16. The walls are variable, being sometimes reticular, but with extra- and wall trabeculæ traceable; within this the 12 septal granules are small and distinct; pali only in traces.

P. Red Sea 1. The high walls may be either reticular, with traces of septal and palic trabeculæ inside, or solid, as if built up of sharply-tilted median flakes upon a synapticular wall or shelf made of wall trabeculæ, and, within, the 12 small septal trabeculæ as pali.

Doubtful:—

P. Solomon Islands 6. The thin lamellate septa with ragged edges, with very irregular plate-like pali, seem here and there to admit of this interpretation.

b, i. With the 3 rings of trabeculæ inside the "extra" median line, but with development of both septal trabeculæ and pali.

P. New Guinea 3. With wall, septal, and palic granules separated by concentric furrows, and diminishing in size towards the centre.

P. Sandwich Islands 6. Difficult to unravel, but 3 rings of granules appear at times within the thin glassy walls.

P. Great Barrier Reef 8. With 3 rings present, except where walls are reticular.

P. North-West Australia 3. Appear to be 3 rings greatly cramped together.

P. North-West Australia 5. All the rings regular and distinct.

P. Philippines 3. Three rings appear on the top of the stock, but at the sides only two (see C, *a*).

P. Persia 2. Calicles very angular. Frequent appearance of 3 rings within the thin walls.

[N.B.—In the following two sub-divisions an asterisk means that the presence of extra wall trabeculæ is not uniform over the whole colony, the walls varying everywhere in thickness.]

b, ii. With 2 rings of trabeculæ distinct within the calicle, viz. the septal and the palic. The wall trabeculæ form, with the extra trabeculæ, compound dividing walls between adjacent calicles.

**P. Tonga Islands 7.* On the under surface only, where alone the extra trabeculæ appear.

P. Great Barrier Reef 41. The "wall" trabeculæ appear regularly round the margin of the flattened dividing wall.

P. North-West Australia 1. Flat flaky walls, with extra and "wall" granules; the septal and palic granules very irregular, but traceable within the calicle.

P. Banda Sea 1. Walls reticular and very irregular in character and thickness.

P. Timor-laut 1. Wherever trabeculæ are traceable at all, e.g. on the under surface, the thick reticular walls surround septal and palic granules (see D, *a*).

P. Singapore 1. With walls thin or reticular, but with clear ring of septal trabeculæ.

P. Singapore 4. Thick, solid, granular walls, often with coarse median ridge. Septal and palic rings pronounced.

P. Singapore 6. The wall, showing a tendency to have an inner shelf, surrounds a clear ring of small septal granules, within which are large compact pali.

**P. Ceylon 4.* With walls variable; two distinct inner rings.

**P. Ceylon 5* differs from *4* in smallness of calicles and extreme tenuity of septa.

P. Ceylon 7 and *8* differ from *4* only in characters of the skeletal elements.

**P. Amirantes 3.* With complete rings of septal and palic trabeculæ, with walls frequently reticular.

P. Providence Islands 1. The walls mostly thicker and coarser than those of *P. Amirantes 3* (see last entry).

P. Red Sea 2. With wall raised, convex, reticular, and of varying thickness.

b, iii. With one single ring distinct within the calicle, viz., the pali; the extra, wall, and septal trabeculæ, as far as they can be made out, together form the compound wall.

**P. Society Islands 1.* Wall appears at times to consist of 3 rings of trabeculæ.

P. Solomon Islands 1. Wall appears to consist of three rings of trabeculæ.

P. Solomon Islands 2. Septal trabeculæ either quite involved in, or serrating the inner margin of, the walls.

**P. Caroline Islands 4.* Wall a close reticulum but of variable thickness.

P. Great Barrier Reef 1. Convex reticular walls, with septal trabeculæ serrating the margin.

P. Great Barrier Reef 27. Broad, flaky walls, with septal trabeculæ sometimes free.

**P. Great Barrier Reef 28* and *29.* Walls proliferate into foaming filamentous reticulum with septal trabeculæ serrating inner margin.

**P. Great Barrier Reef 32* and *39.* The septal trabeculæ here and there free.

P. North-West Australia 7. Septal granules irregularly involved in thick convex reticular walls.

P. Singapore 3. Thick, slightly convex, reticular walls, septal granules sometimes free and sometimes involved.

Other cases in which extra trabeculæ appear in the wall are given below in Division E, *b*. In the following it is doubtful how far the extra trabeculæ are normal.

P. Ellice Islands 15 and *P. North-East Australia 2* are very small convex masses with gaping calicles, and may be merely young stages.

Other doubtful forms may be mentioned, *P. China Sea 7*, *P. Ellice Islands 3*, in both of which the trabecular arrangement is difficult to make out.

C. *Those in which there are typically no extra trabeculæ, but the "wall" trabeculæ (*w *of the diagrams) form the middle line between adjacent calicles.*

The following are the chief sub-divisions:—

a. These "wall" trabeculæ are the only constituents of the thin walls, and the other two rings, septal and palic, are free and distinct within the calicle.

b. The septal trabeculæ may be variously associated with the wall trabeculæ.

i. Forming an inner ring or shelf. (Gardiner's "Trimurate" condition, see Introduction, p. 16.)

ii. The septal trabeculæ may be united to the wall trabeculæ by broad, flaky, tongue-like septa, representing great development of the horizontal elements of the skeleton.

iii. The septal trabeculæ are arranged very close to the wall, which then rises like a sharp ridge, being slowly thickened on each side by an irregular reticular buttress composed of the septal trabeculæ and their junctions.

iv. The septal trabeculæ may rise up high, and form, with the wall trabeculæ, a reticular wall without median ridge. The pali are then the only free and distinct ring within the calicle.

v. The septal trabeculæ are partially aborted, and the diminution of the calicle has reached its limit, except in such extremes as *P. Great Barrier Reef 5*, in which the pali also suffer diminution.

a. Walls single with two clear rings of septal and palic trabeculæ.

P. Tonga Islands 4. With walls thin and membranous; calicles here and there very small, and then belonging to sub-division *b*, v.

P. Sandwich Islands 7. With walls here high, thin, and membranous, there zig-zag and low.

P. Great Barrier Reef 8. With walls slightly raised, sometimes zig-zag and thickened; the granules or tips of trabeculæ tend to be rectangular, and are finely echinulate.

P. Great Barrier Reef 14. The septal trabeculæ are clear when the wall is thin and zig-zag, but when the walls thicken, they become involved in the reticulum.

P. Great Barrier Reef 20. With walls membranous, and septal trabeculæ as lamellate plates projecting inwards and upwards.

P. Great Barrier Reef 25. With tendency to form an inner wall. See *b*, i.

P. Great Barrier Reef 30. With walls and internal skeleton all thin, straggling, and lamellate; calicles large.

P. Great Barrier Reef 31. With calicles very small; where the walls thicken the septal trabeculæ become involved.

P. Great Barrier Reef 35. With walls thin, incomplete, and zig-zag; the trabeculæ pronounced, and horizontal elements feeble.

P. North-West Australia 4. On the top, but down the sides the calicles pass through stages *b*, iii. and *b*, iv.

P. Philippines 3. On the top belonging to B with three inner rings, but at the sides two rings alone distinct, but the relations are often obscure.

P. China Sea 11. The surface view of the granules shows two clear rings within polygonal walls, but variable, here as in *b*, iii., there as in *b*, iv.

b. Wall and septal trabeculæ variously associated.

i. The septal trabeculæ form a regular inner wall or shelf. (The "trimurate" condition.)

P. Fiji Islands 2. With the septal trabeculæ variously united, sometimes as a smooth shelf, sometimes as a regular network.

P. Ellice Islands 6. The wall trabeculæ as continuous, straggling, median lines, on the same level with the septal granules.

P. Ellice Islands 7. The same.

P. Ellice Islands 11. The same, only obscured by frosting of the otherwise thin skeletal elements.

P. Solomon Islands 7. A stout, open, smooth skeleton; the septal trabeculæ are either as here or as under *b*, iv., or, again, quite irregular.

P. Sandwich Islands 8. Typical.

P. Great Barrier Reef 22. The wall narrow, straight, and echinulate; inner wall fairly uniform, but not very pronounced.

P. Great Barrier Reef 25. In parts only. (See also C, *a*.)

P. Great Barrier Reef 33. The median ridge may be a distinct, delicate, zig-zag thread, on each side of which the septal trabeculæ unite into regular rings.

P. Singapore 5. With thread-like, echinulate walls, and very wide, straggling, flaky shelf, from the edges of which echinulate septal granules project; here and there these latter divide into two, suggesting the group B, *a*.

P. Ceylon 1. A fluent reticulum, often with three concentric lines in the walls, and apparently belonging to B, i.; comparison with *P. Ceylon 2*, however, shows it to belong here.

P. Ceylon 2. With much smaller calicles than No. 1.

P. Ceylon 3. Cf. *P. Ceylon 1.*

P. Ceylon 10. The skeleton a light, open network, with walls thin and raised, with regular synapticular ring.

P. Ceylon 16. With traces of a skeletal ring visible in the otherwise fluent network.

P. Maldives 1. Walls excessively thin and membranous, here showing traces of inner ring, there as in *b*, iv.

P. Diego Garcia 2. With walls thin and raised, with scattered echinulæ; inner ring pronounced.

b, ii. The septal trabeculæ joined to the wall trabeculæ by broad, flaky septa, representing great development of the horizontal layer.

P. Fiji Islands 3. The septal granules as small, woolly knobs.

P. Fiji Islands 6. Wall and septal granules confused on the apparently convex surfaces of the septal flakes.

P. Fiji Islands 19. With wall tall and irregularly thickened by many tiers of short flakes; the septal trabeculæ appear at irregular levels, and the pali deep down.

P. Ellice Islands 4. Flat, flaky walls, with straggling wall granules, and septal granules at the tips of upper flakes, and the pali on the tips of lower; calicles minute.

P. Great Barrier Reef 3. The wall flakes large, the tips of trabeculæ minute and far apart.

P. Great Barrier Reef 11. With flakes bold and large, the tips of the trabeculæ hardly visible, except those of the wall and pali.

P. Great Barrier Reef 17. With very confused lines of bushy granules on the median ridges of the flaky walls.

P. Great Barrier Reef 19. The septal granules mostly as short, rounded flakes, projecting from the inner margin of the walls.

P. Great Barrier Reef 24. With very broad, flat-topped, flaky, but reticular walls, with threads and striæ on their top surfaces; with outline of calicle quite irregular (? belonging to B).

P. Great Barrier Reef 26. On the tips of the branches the flakes stand up, making the calicles deep, but at the sides the walls are flat.

P. China Sea 17. With the flaky walls nearly solid; wall granules not pronounced; septal granules and pali on tops of flakes; all flush with the surface, with the fossa obscured.

b, iii. The septal trabeculæ variously united into a buttress, frequently reticular, and gradually or suddenly thickening the wall from below upwards.

P. Tonga Islands 2. With stout, tall, ragged wall edges, septa irregularly joined together, slope steeply down round deep fossa.

P. Tonga Islands 3. With stout, smooth, low wall-edges; septa slope gradually round deep fossa.

P. Fiji Islands 7. With walls as tall, stout ridges of granules; stout septa slope steeply and irregularly.

P. Fiji Islands 18. Same, where calicles are large; where small, cf. *b*, v.

P. Fiji Islands 20. With septal trabeculæ only here and there visible, thickening the wall; cf. also *b*, v.

P. Fiji Islands 21. The same, only with minute calicles.

P. Ellice Islands 14. With thin, straight, frosted walls, against which the minute septal trabeculæ rise to various heights, though without showing any reticular formation.

P. New Hebrides 1. With walls stout, straight, denticulate, striated longitudinally by the septal trabeculæ, which are joined at irregular heights by rods to the pali.

P. Solomon Islands 8. See also *b*, iv.

P. Great Barrier Reef 2. A bold, open, flaky reticulum, with a thin, straggling, median ridge; the septal trabeculæ as minute granules at the tips of wall flakes.

P. Great Barrier Reef 4. The septal trabeculæ project irregularly and roughen the walls, without forming any reticulum; see also *b*, v.

P. Great Barrier Reef 13. With walls thin and perpendicular, septal trabeculæ in contact with them, and sometimes showing traces of uniting into an irregular inner wall (as in *b*, i.).

P. Great Barrier Reef 34. On the top with walls straight, stout, and very frosted, the buttresses steep and scanty; at the sides the walls appear broad, making the calicles shallow and funnel-shaped.

P. Great Barrier Reef 36. With the tips of the wall trabeculæ as frosted granules; the septal trabeculæ either just free of or involved in thickening walls, passing into *b*, iv. (which see).

P. China Sea 6. This character occurs where the walls are straight rows of frosted granules; elsewhere passing into *b*, iv.

P. China Sea 16. With walls tall, thin, and straight; septal trabeculæ rise to various heights close to walls, and irregularly joined together.

P. Ceylon 18. With walls tall, thin, and straight, and septal trabeculæ close to walls, rising to different heights, and variously joined together and to the pali, often incomplete.

P. Rodriguez 2. This character seen at the sides; for the top, see below, *b*, iv.

P. Cape of Good Hope 1. With septal trabeculæ close to walls (? also as in *b*, v.).

b, iv. The septal trabeculæ rise up with the wall trabeculæ, and together form a reticulum convex or flat-topped.

P. Tonga Islands 6. With walls showing all stages between being thin, membranous and single, and being united with septal trabeculæ to form a delicate reticulum.

P. Tonga Islands 7. The same, though with traces of extra trabeculæ, cf. B.

P. Fiji Islands 23. With wall- and septal trabeculæ, as if united to form transverse striæ across the wall-tops.

P. Fiji Islands 24. With wall- and septal trabeculæ united into an irregular, flaky wall, from which their often branching tips arise.

P. Ellice Islands 1. The same, only the wall- and septal granules unite so as to striate the walls.

P. Ellice Islands 2. With the septal trabeculæ involved in bold reticular walls.

P. Ellice Islands 12. With walls as a close, convex, flaky network.

P. Ellice Islands 13. The same, but only here and there, walls mostly thin and membranous (see *b*, v.).

P. Ellice Islands 17. The septal trabeculæ involved with zig-zag wall in stout, open, irregular, but really simple, wall reticulum.

P. Solomon Islands 7. With the septal trabeculæ as here, or else free and irregular (as in *b*, i.).

P. Solomon Islands 8. With skeleton granular and frosted, belonging here when the wall is round and convex, or to *b*, iii. when with a straight, sharp median wall ridge.

P. New Guinea 2. With the walls irregularly zig-zag, here thin and thread-like, there involved with the septal trabeculæ into a reticulum; calicles flush with the surface.

P. Bay of Panama 1. With the details rather obscured by the echinulate character of the skeleton.

P. Sandwich Islands 5. With flat-topped wall only in parts; other parts may belong to section B.

P. Great Barrier Reef 15. With walls, a flaky reticulum with median keel; septal trabeculæ mostly lost in the wall.

P. Great Barrier Reef 16. With walls appearing flaky, but with confused branching and reticular threads on their tops.

P. Great Barrier Reef 28 and 29. With walls round-topped, frequently as fine, delicate, small-meshed networks.

P. Great Barrier Reef 33. With walls as an elegant network, with, however, faint median ridges; in parts, as in *b*, i.

P. Great Barrier Reef 36. The walls convex, with a faint median keel (see also *b*, iii.).

P. Great Barrier Reef 37. With wall either a stout and filamentous, or slightly flaky reticulum.

P. North-East Australia 1. With walls regularly reticular or solid looking and flaky. The pali rise irregularly to some height, and may be joined to the wall by septal bars.

P. North-West Australia 4. See C *a* for the topmost calicles; round the edges, broad flat irregular walls are striated irregularly.

P. North-West Australia 6. The flat-topped walls with irregular margins and a loose system of branching filaments striating their tops.

P. Philippines 5. With walls as a very simple open network in which the different skeletal elements can be easily traced.

P. China Sea 5. With bold, open and flaky wall, having a slight ridge. The horizontal elements are stout and the trabeculæ irregular.

P. China Sea 6, passes from *b*, iii. to this sub-division on all eminences where the walls thicken.

P. China Sea 8. With rounded solid-looking walls, minute jagged points marking the rings of the component trabeculæ; a very large palic ring flush with the walls.

P. China Sea 11. With rounded solid walls, having straight, median rows of frosted granules, with regular rings of similar granules on the inner margins, and regular pali, all flush with the walls. See also C, *a*.

P. China Sea 13. With flaky walls rising to a ridge, but wall- and septal granules are indistinguishable.

P. China Sea 14. With very tall walls, single or reticular, and surging up into ramparts. Septal and wall trabeculæ confused and indistinguishable.

P. Ceylon 12. With flat-topped walls with scattered granules and very irregular inner margins.

P. Maldives 1. Walls either a light network, or very thin and membranous with inner ring (see *b*, i.).

P. Rodriguez 1. The reticular network of the wall is level-topped and varies in thickness. The pali are very pronounced.

P. Rodriguez 2. A reticular network over the top of the stock. At the sides as in *b*, iii., with walls thin.

P. Red Sea 5. Walls flaky, smooth, or striated.

b, v. The septal trabeculæ are partially wanting.

P. Tonga Islands 4. Already mentioned in C, *a*. In parts the septal trabeculæ only seen in angles of the polygonal calicles.

P. Tonga Islands 5. With walls thin, membranous, and ragged. The septal trabeculæ very feebly developed. Pali flaky.

P. Fiji Islands 18. With wall stout and sharp-edged; septal striæ slope steeply down; cf. also *b*, iii.

P. Fiji Islands 20. With wall stout and sharp-edged; septa spring out at right angles towards the pali.

P. Fiji Islands 21. The same, only with minute calicles.

P. Fiji Islands 22. On the upper surface only; on lower, the septal granules appear in the dense mósaic of the flat walls.

P. Ellice Islands 13. With walls thin, membranous, and slightly zig-zag; scattered septal trabeculæ at times involved in the wall (as in *b*, iv.).

P. Solomon Islands 5. With thin, thread-like walls, and only scattered septal trabeculæ close to wall; in the angles of calicles they form portions of an inner wall (as in *b*, i.).

P. Great Barrier Reef 4. The septal granules when present seem only to roughen the inner faces of the raised walls; see also *b*, iii.

P. Great Barrier Reef 5. The wall trabeculæ are long, stout, smooth rods; septal *and palic* trabeculæ irregular and scanty. (N.B.—This form shows the greatest reduction so far known in the genus in the number of the intra-calicular trabeculæ.)

P. Great Barrier Reef 6. With walls very irregular, seldom reticular; septal trabeculæ only in traces.

P. Great Barrier Reef 7. With septal trabeculæ either absent or involved in the wall, which is composed of stout, smooth trabeculæ in confused single or double rows, seldom forming a reticulum, but showing traces of a zig-zag arrangement.

P. Great Barrier Reef 40. With mostly very narrow, irregularly flaky walls, with only scattered septal trabeculæ.

P. North Australia 5. With tall, stout, but quite irregular walls, as if of tiers of thick flakes; trabeculæ obscured.

P. North-West Australia 2. With the septal trabeculæ involved in an open, straggling, very irregular wall, showing a tendency to be flaky.

P. North-West Australia 8. With walls thin, here and there reticular—that is, with a few septal trabeculæ involved.

P. Banda Sea 2. Only on the tips of the branches; the walls of the lower parts are too flaky to allow the trabeculæ to be distinguished.

P. Singapore 2. With the septal trabeculæ aborted or confused in thin, straggling walls.

P. Christmas Island 1. Belongs here, when the walls are thin, but to *b*, iv. when they are reticular.

P. Ceylon 13. With septal trabeculæ confused in the zig-zag walls.

P. Diego Garcia 1. With walls very tall and thin, the septal trabeculæ either wanting or forming a very thin reticulum close to wall and very deep down. Skeleton open.

P. Cape of Good Hope 1. With septal trabeculæ apparently confused with the thin zig-zag walls (? also *b*, iii.).

Observations on Tables B *and* C.—A glance at these tables, beginning as they do with the largest calicles known in *Porites*, in which the extra trabeculæ function as the middle line between adjacent calicles, shows a progressive diminution down to the last sub-division, C, *b*, v., in which it is possible almost to regard the septal trabeculæ as forming the median line. In the former case 3 rings of trabeculæ are incorporated in the intra-calicular skeleton,

in the latter only one—and in *P. Great Barrier Reef 5* even that remaining ring is greatly diminished. Looking at the sizes of the sub-divisions, it is interesting to note that the largest number of forms occurs in the last division but one (*b*, iv.), in which the wall and septal trabeculæ unite to form the dividing walls between adjacent calicles, leaving only 1 ring of trabeculæ in the intra-calicular skeleton. The tendency of the genus is clearly then towards minute calicles.

It is also noteworthy that this minuteness of calicle is attained within the genus in two ways: (1) as above described, by what looks like rapid budding and consequent crowding, so that the number of rings of trabeculæ to each calicle is gradually cut down to one, viz., the pali; and (2) as seen in the cœnenchymatous forms, where the walls are greatly thickened, and where perhaps we may say that, as in *Montipora*, which is the smallest calicled Madreporid, the calicles have suffered in order that the walls might be especially developed.

D. Those *Porites* in which the trabecular elements are no longer recognisable, either (*a*) because the whole skeleton is melted down into a fluent network, or (*b*) because the horizontal elements are developed at the expense of the trabecular.

a. This applies to all tops of forms which show the expanding sheaf method of growth; also to—

P. Timor-laut 1. On all the top surface, perhaps indicating the method of growth just mentioned (see B, *b*, ii.).

P. Ceylon 1 and *3.* A fluent network, explained perhaps by *P. Ceylon 2* (see C, *b*, i.).

P. Ceylon 6. Skeleton consists of vertical lamellæ, perhaps also indicative of the expanding sheaf method of growth.

P. Ceylon 11. It is doubtful whether this has not had the original surface worn down. (The fact that the skeletal elements can be seen to be hollowed out by a boring alga confirms this suggestion.)

P. Red Sea 5. (See the British Museum specimen.)

b. The horizontal elements developed at the expense of the trabecular, the tips of which are usually just traceable as minute granules. (The opposite extreme to this is *P. Great Barrier Reef 5*, in which the trabeculæ run to an extreme in length and size, though their numbers are reduced to a minimum.)

P. Banda Sea 2
P. Philippines 6
P. China Sea 4
P. Java Sea 2
P. Singapore 7
} See descriptions in text.

E. Branching non-cœnenchymatous forms, the tips of which mostly consist of a streaming axial reticulum, show the following variations in their calicles.

a. The walls rise in the usual manner, showing no special development of either the trabecular or horizontal layers.

b. The trabecular layers are especially developed, the tips of the trabeculæ making a smooth mosaic over the surface.

c. The horizontal layers are most developed, so that the surface consists of flat flakes, with the trabeculæ as scattered granules.

a. Neither trabecular nor horizontal or concentric layers prominent.

P. Java Sea 2. The skeleton a confused reticulum, tending to be smooth and flaky.

P. Maldives 2.
P. Mauritius 3 and 5.
P. Amirantes 2.
P. Amirantes 3.
P. Providence Islands 1.
} See description in text and figures.

b. The trabecular layers are conspicuous, often with an extra wall trabecula (see B above), especially in the basal regions, where growth in thickness continues after the budding has ceased.

P. Samoa 1. With surface as a mosaic of granules; extra wall trabeculæ mostly present.

P. Tonga Islands 8. The walls slightly raised and rounded, but gradually flattening as a smooth mosaic; an extra wall trabecula mostly present.

P. Tonga Islands 9. With walls mostly flat and showing extra wall trabeculæ,

P. Fiji Islands 1. Extra wall trabeculæ chiefly near the base, where the granules tend to be rectangular and echinulate.

P. Ellice Islands 16. Extra wall trabeculæ are present near the base.

P. Solomon Islands 3. Extra wall trabeculæ; wall a thin faint ridge over upper part of stocks.

P. Solomon Islands 9. Extra wall trabeculæ very frequent in all parts.

P. Great Barrier Reef 12. Extra trabeculæ chiefly round the basal parts; here and there the granules are expanding to form next horizontal layer, and the surface then looks hard, smooth and flaky.

P. Great Barrier Reef 18. The surface is here velvety from the small echinulate tips of the trabeculæ; there, more smooth and solid-looking as the next horizontal layer is being developed.

P. North Australia 2. With extra trabeculæ to basal calicles; the concentric elements appear conspicuously between the wall trabeculæ.

P. North Australia 7. The intra-calicular skeleton is trabecular; the walls are delicately flaky, with scattered granules on their surfaces.

P. Kokos Island 1. The walls are flaky, but the intra-calicular skeleton is trabecular.

P. Maldives 3. With traces of extra trabeculæ.

P. Diego Garcia 3. It is difficult to say whether trabecular or horizontal elements are here best developed. The few last forms here given supply us with transitions between this and the next sub-division.

c. The forms in which the horizontal or concentric layers are strikingly developed at the expense of the trabecular.

P. Tonga Islands 10. The trabecular granules still large and conspicuous, but scattered.

P. Great Barrier Reef 3. Somewhat confused skeleton, owing to irregularity of the flakes and the granules.

P. Great Barrier Reef 11. With septa as long, conspicuous tongues.

P. North Australia 5. Calicles large, deep and open, the septa as tiers of flakes.
P. North Australia 8. Also with long, conspicuous, tongue-like septal flakes.
P. Banda Sea 2. With the septal and wall flakes confused, large and ragged, obscuring the radial symmetry.
P. China Sea 17 and 18. With septal and wall flakes distinct, but somewhat unsymmetrically arranged.
P. Singapore 7. The septal flakes distinct, and rounded towards the fossa.

These Tables conclude this attempt to describe the Indo-Pacific *Porites.* The student will find that Table IV. has brought new characters to light which are certainly the best—best where all are bad—for the purposes of any preliminary dividing of the forms into morphological groups. But the tables themselves at the same time make it perfectly clear that these groups cannot be regarded as genetic species. They are too large, too variable in themselves, and their distribution—which is seen at a glance in their designations—is too scattered. But in addition to these difficulties, we have once more to emphasise the fact that the characters relied upon have not the necessary stability to warrant any such supposition. What one would think should *à priori* be the most stable of all characters in the calicular skeleton—viz. the structure of the dividing wall—seems to depend not only upon the accidental forms assumed by the colonies, but even upon the positions of the calicles on these colonies.

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—— *2*, **146**, 286.
—— *3*, **147**, 275.
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—— *5*, **149**, 284, 287.
—— *6*, **150**, 222.
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—— *2*, **145**, 283.
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—— *6*, 33, **241**, 275.
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—— *3*, **100**.
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—— *5*, 100, **101**, 103, 282.
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—— *2*, **29**, 40, 80, 99, 274.
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—— *6*, **86**, 277.
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—— *5*, **37**, 283.
—— *6*, **37**, 87, 282.
—— *7*, 36, 37, **38**, 44, 277, 282.
—— *8*, **39**, 41, 286.
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EXPLANATION OF THE PLATES.

PLATES I.–XII., XIV.–XX., AND XXII.–XXXIV.—Collotypic reproductions of photographs taken by Mr. Murray (of Messrs. Morgan & Kidd); except where they show the growth-form, they are magnifications (× 5) of portions of the surfaces in order to show the finer structure of the calicles.

PLATES XIII., XXI., AND XXXV.—Lithographic reproductions from drawings of the specimens, by Mr. A. T. Hollick, to illustrate the growth-forms alone, without regard to relative sizes; the approximate reductions in each case are given in the following descriptions.

PLATE I.

FIG.

1 and 2. Upper and lower calicles of *P. Society Islands 1*; for growth-form, cf. Pl. XIII. fig. 1.
3 and 4. From specimen *d* of *P. Society Islands 3*.
5. From specimen *g* of the same; for growth-form, cf. Pl. X. fig. 5.
6. „ *P. Samoa 1*; for growth-form, cf. Pl. XIII. fig. 2.
7. „ *P. Tonga Islands 2*; for growth-form, cf. Pl. XIII. fig. 3.
8. „ *P. Tonga Islands 3*.
9. „ *P. Tonga Islands 4*; for growth-form, cf. Pl. XIII. fig. 4.

PLATE II.

1. From the top of *P. Tonga Islands 5*; for growth-form, cf. Pl. XIII. fig. 5.
2. „ *P. Tonga Islands 6*; for growth-form, cf. Pl. XIII. fig. 6.
3 and 4. From the top and bottom respectively of *P. Tonga Islands 7*.
5 and 6. „ *P. Tonga Islands 8*; for growth-form, cf. Pl. X. fig. 6.
7. From *P. Tonga Islands 9*; for growth-form, cf. Pl. X. fig. 7.
8. „ *P. Tonga Islands 10*; „ „ Pl. XI. fig. 1.
9. „ *P. Fiji Islands 1*.

PLATE III.

1 and 2. From specimen *a* of *P. Fiji Islands 2*; for growth-form, cf. Pl. XI. fig. 3.
3. From specimen *b* of the same.
4. „ „ *d* „
5. „ *P. Fiji Islands 3*; for growth-form, cf. Pl. XIII. fig. 7.
6 and 7. From top and projecting edge of *P. Fiji Islands 4*; for growth-form, cf. Pl. XIII. fig. 8 diagram.
8. From *P. Fiji Islands 6*; for growth-form, cf. Pl. XIII. fig. 9.
9. Top calicles of *P. Fiji Islands 7*; for growth-form, cf. Pl. XIII. fig. 8 diagram.

PLATE IV.

FIG.
1. From *P. Fiji Islands 18*; for growth-form, cf. Pl. XIII. fig. 10.
2, 3 and 4. From specimens *a*, *c* and *d*, of *P. Fiji Islands 19*; for growth-form, cf. Pl. XIII. fig. 11.
5. From *P. Fiji Islands 20.*
6. „ *P. Fiji Islands 21*; for growth-form, cf. Pl. XIII. fig. 12.
7 and 8. From projecting edge and from under-surface of *P. Fiji Islands 22*; for growth-form, cf. diagram, Pl. XIII. fig. 8.
9. From *P. Fiji Islands 23.*

PLATE V.

1. From *P. Fiji Islands 24*; for growth-form, cf. Pl. XIII. fig. 13.
2. „ *P. Ellice Islands 1*; „ Pl. XIII. fig. 14.
3. „ *P. Ellice Islands 2*; „ Pl. XIII. fig. 15.
4 and 5. From detached fragments *b* and *a* of *P. Ellice Islands 3*; for growth-form of *a*, cf. Pl. XI. fig. 2.
6. From *P. Ellice Islands 4*; for growth-form, cf. Pl. XIII. fig. 16.
7 and 8. Upper and lower calicles of *P. Ellice Islands 5*; cf. diagram, Pl. XIII. fig. 8.
9. Upper calicles of specimen *b* of same.

PLATE VI.

1 and 2. From the top and from below the edge of *P. Ellice Islands 6.*
3. From *P. Ellice Islands 7* (? a rounded form of the last).
4. „ *P. Ellice Islands 8*; for growth-form, cf. Pl. XIII. figs. 17 and 18.
5 and 6. Upper surface and under the edge of *P. Ellice Islands 9.*
7 and 8. From two opposite sides of *P. Ellice Islands 10*; for growth-form, cf. Pl. XIII. fig. 19.
9. Showing two variations of calicles of *P. Ellice Islands 11*, cf. Pl. VII. fig. 1; for growth-form, cf. Pl. XIII. fig. 20.

PLATE VII.

1. A third variation in the calicles of *P. Ellice Islands 11*, cf. Pl. VI. fig. 9; for growth-form, cf. Pl. XIII. fig. 20.
2. The reticular walls of *P. Ellice Islands 12*; cf. Pl. XIII. fig. 21.
3. The peculiar striated walls of the same at the patch marked by an asterisk on Pl. XIII. fig. 21.
4. The normal calicles of *P. Ellice Islands 13.*
5. The peculiar wall-formation on the patch marked by an asterisk on Pl. XIII. fig. 22.
6. From one of the ridges of *P. Ellice Islands 14*; for growth-form, cf. Pl. XIII. fig. 23 *a* and *b*.
7. From *P. Ellice Islands 15.*
8. Calicles about halfway down of *P. Ellice Islands 16*; for growth-form, cf. Pl. XIII. fig. 24.
9. From *P. Ellice Islands 17* (? with walls rubbed off); „ Pl. XIII. fig. 25.

PLATE VIII.

FIG.
1. From top of *P. New Hebrides 1.*
2. „ *P. Solomon Islands 2.*
3. „ *P. Solomon Islands 5*; for growth-form, cf. Pl. XIII. fig. 26.
4. „ *P. Solomon Islands 7*; „ Pl. XIII. fig. 28.
5 and 6. From top and lower edge of *P. Solomon Islands 6*; for growth-form, cf. Pl. XI. fig. 6.
7. From *P. Solomon Islands 8*; for growth-form, cf. Pl. XIII. fig. 27.
8. „ *P. Solomon Islands 9*; „ „ Pl. XI. fig. 7.
9. „ *P. Solomon Islands 3*; „ „ Pl. XI. fig. 4.

PLATE IX.

1. From *P. Solomon Islands 1.*
2. „ *P. Solomon Islands 4*; for growth-form, cf. Pl. XI. fig. 5.
3. „ *P. New Guinea 2.*
4. „ *P. New Guinea 3.*
5 and 6. From *P. Caroline Islands 3*; for growth-form, cf. Pl. XII. figs. 1, 2 and 3.
7. From *P. Caroline Islands 4*; for growth-form, cf. Pl. XII. fig. 4.
8. „ *P. Sandwich Islands 5.*
9. „ *P. Sandwich Islands 6*; for growth-forms, cf. Pl. XII. fig. 5.

PLATE X.

1. From *P. Sandwich Islands 7*; for growth-form, cf. Pl. XII. fig. 6.
2. „ *P. Sandwich Islands 8.*
3. „ *P. Bay of Panama 1.*
4. Growth-form of *P. Society Islands 2*, × ½.
5. „ *P. Society Islands 3*, × ½; for the calicles, cf. Pl. I. fig. 5, also figs. 3 and 4.
6. „ *P. Tonga Islands 8*, × ⅓; „ Pl. II. figs. 5 and 6.
7. „ *P. Tonga Islands 9*, × ½; „ Pl. II. fig. 7.

PLATE XI.

1. Growth-form of *P. Tonga Islands 10*, × ½; for the calicles, cf. Pl. II. fig. 8.
2. „ *P. Ellice Islands 3*, × ½; „ Pl. V. figs. 4 and 5.
3. „ *P. Fiji Islands 2*, × ⅓; for the calicles, cf. Pl. III. figs. 1 and 2 (specimen *a*), fig. 3 (specimen *b*), fig. 4 (specimen *d*).
4. „ *P. Solomon Islands 3*, × ⅔; for the calicles, cf. Pl. VIII. fig. 9.
5. „ *P. Solomon Islands 4*, × ½; „ Pl. IX. fig. 2.
6. „ *P. Solomon Islands 6*, × ½; „ Pl. VIII. figs. 5 and 6.
7. „ *P. Solomon Islands 9*, × ⅓; „ Pl. VIII. fig. 8.

PLATE XII.

FIG.
1. Growth-form of *P. Caroline Islands 3* (specimen *a*), × $\frac{4}{3}$; for the calicles, cf. Pl. IX. fig. 5.
2. „ *P. Caroline Islands 3* (specimen *b*), × $\frac{1}{2}$.
3. „ *P. Caroline Islands 3* (specimen *d*), × $\frac{1}{3}$; for the calicles, cf. Pl. IX. fig. 6.
4. „ *P. Caroline Islands 4*, × $\frac{1}{3}$; for the calicles, cf. Pl. IX. fig. 7.
5. „ *P. Sandwich Islands 6*, × $\frac{1}{3}$; „ Pl. IX. fig. 9.
6. „ *P. Sandwich Islands 7*, × $\frac{1}{2}$; „ Pl. X. fig. 1.

PLATE XIII.

LITHOGRAPHIC REPRESENTATIONS OF GROWTH-FORMS.

With approximate reductions.

1. *P. Society Islands 1*, × $\frac{1}{3}$; for the calicles, cf. Pl. I. figs. 1 and 2.
2. *P. Samoa 1*, × $\frac{1}{2}$; for the calicles, cf. Pl. I. fig. 6.
3. *P. Tonga Islands 2*, × $\frac{1}{3}$; for the calicles, cf. Pl. I. fig. 7.
4. *P. Tonga Islands 4*, × $\frac{1}{2}$; „ Pl. I. fig. 9.
5. *P. Tonga Islands 5*, × $\frac{1}{2}$; „ Pl. II. fig. 1.
6. *P. Tonga Islands 6*, × $\frac{1}{2}$; „ Pl. II. fig. 2.
7. *P. Fiji Islands 3*, × $\frac{1}{2}$; „ Pl. III. fig. 5.
8. A Diagram to explain the table-topped method of growth; cf. *P. Fiji Islands 4*.
9. *P. Fiji Islands 6*, × $\frac{2}{5}$; for the calicles, cf. Pl. III. fig. 8.
10. *P. Fiji Islands 18*, × $\frac{2}{3}$; „ Pl. IV. fig. 1.
11. *P. Fiji Islands 19*, × $\frac{1}{2}$; „ Pl. IV. figs. 2, 3 and 4.
12. *P. Fiji Islands 21*, × $\frac{3}{5}$; „ Pl. IV. fig. 6.
13. *P. Fiji Islands 24*, × $\frac{2}{3}$; „ Pl. V. fig. 1.
14. *P. Ellice Islands 1*, × $\frac{2}{5}$; „ Pl. V. fig. 2.
15. *P. Ellice Islands 2*, × $\frac{1}{2}$; „ Pl. V. fig. 3.
16. *P. Ellice Islands 4*, × $\frac{2}{5}$; „ Pl. V. fig. 6.
17. *P. Ellice Islands 8* (specimen *a*), × $\frac{1}{2}$; for the calicles, cf. Pl. VI. fig. 4.
18. *P. Ellice Islands 8* (specimen *b*), × $\frac{1}{3}$.
19. *P. Ellice Islands 10*, × $\frac{1}{2}$; for the calicles, cf. Pl. VI. figs. 7 and 8.
20. *P. Ellice Islands 11*, × $\frac{1}{2}$; „ Pl. VI. fig. 9, and Pl. VII. fig. 1.
21. *P. Ellice Islands 12*, × $\frac{1}{2}$; „ Pl. VII. fig. 2 (fig. 3 shows the calicles in the patch marked by an asterisk).
22. *P. Ellice Islands 13*, × $\frac{1}{2}$; „ Pl. VII. fig. 4 (fig. 5 shows the calicles in the patch marked by an asterisk).

23, *a* and *b*. The two sides of *P. Ellice Islands 14*, × $\frac{1}{2}$; for the calicles, cf. Pl. VII. fig. 6.

24. The fragment of *P. Ellice Islands 16*, × $\frac{1}{2}$; for the calicles, cf. Pl. VII. fig. 8.
25. The two fragments of *P. Ellice Islands 17*, × $\frac{1}{2}$; for the calicles, cf. Pl. VII. fig. 9.
26. *P. Solomon Islands 5*, × $\frac{1}{3}$; for the calicles, cf. Pl. VIII. fig. 3.
27. *P. Solomon Islands 8*, × $\frac{1}{2}$; „ Pl. VIII. fig. 7.
28. *P. Solomon Islands 7*, × $\frac{1}{2}$; „ Pl. VIII. fig. 4.

PLATE XIV.

FIG.
1. From *P. Great Barrier Reef 1*; for growth-form, cf. Pl. XXI. fig. 1.
2. „ *P. Great Barrier Reef 2*; „ Pl. XXI. fig. 2.
3. „ *P. Great Barrier Reef 3*; „ Pl. XIX. fig. 1.
4. „ *P. Great Barrier Reef 4*; „ Pl. XIX. fig. 2.
5. „ *P. Great Barrier Reef 5*; „ Pl. XIX. fig. 3.
6. „ *P. Great Barrier Reef 6*; for growth-form of *a*, cf. Pl. XIX. fig. 4; of *b*, cf. Pl. XXI. fig. 8.
7. „ *P. Great Barrier Reef 7*; for growth-form, cf. Pl. XXI. fig. 3.
8. „ *P. Great Barrier Reef 8*; „ Pl. XXI. fig. 4.
9. „ *P. Great Barrier Reef 9*; „ Pl. XIX. fig. 5.

PLATE XV.

1. From *P. Great Barrier Reef 10*; for growth-form, cf. Pl. XIX. fig. 7.
2. „ *P. Great Barrier Reef 11*; „ Pl. XIX. fig. 8.
3. „ *P. Great Barrier Reef 13*; „ Pl. XXI. fig. 5.
4. „ *P. Great Barrier Reef 14*; „ Pl. XXI. figs. 6 and 7.
5. „ *P. Great Barrier Reef 15*; „ Pl. XXI. fig. 12.
6. „ *P. Great Barrier Reef 16*; „ Pl. XXI. fig. 9.
7. „ *P. Great Barrier Reef 17.*
8. „ *P. Great Barrier Reef 18.*
9. „ *P. Great Barrier Reef 19*; for growth-form, cf. Pl. XX. fig. 2.

PLATE XVI.

1. From *P. Great Barrier Reef 20*; for growth-form, cf. Pl. XXI. fig. 10.
2. „ *P. Great Barrier Reef 21.*
3. „ *P. Great Barrier Reef 22*; for growth-form, cf. Pl. XXI. fig. 11.
4. „ *P. Great Barrier Reef 23*; „ Pl. XXI. fig. 13.
5. „ *P. Great Barrier Reef 24*; „ Pl. XXI. fig. 14.
6. From top of column, *P. Great Barrier Reef 25*; for growth-form, cf. Pl. XXI. fig. 17.
7. From side near the top, *P. Great Barrier Reef 25.*
8. From the tips of *P. Great Barrier Reef 26*; for growth-forms, cf. Pl. XX. fig. 1, and Pl. XXI. fig. 16.
9. From the sides of the same.

PLATE XVII.

1. From *P. Great Barrier Reef 27*; for growth-form, cf. Pl. XXI. fig. 15.
2. „ *P. Great Barrier Reef 28*; „ Pl. XXI. figs. 18 and 19.
3. „ specimen *a* of *P. Great Barrier Reef 29*; for growth-form, cf. Pl. XXI. fig. 21.
4. „ „ *b* of the same.
5. „ „ *f* „
6. „ *P. Great Barrier Reef 30*; for growth-form, cf. Pl. XXI. fig. 22.
7. „ *P. Great Barrier Reef 31*; „ Pl. XXI. fig. 20.
8. „ *P. Great Barrier Reef 32*; represents only one extreme variation of the calicles, viz. those with thick reticular walls; cf. Pl. XXI. fig. 23.
9. „ *P. Great Barrier Reef 33.*

PLATE XVIII.

FIG.

1. From *P. Great Barrier Reef 34.*
2. „ *P. Great Barrier Reef 35*; for growth-form, cf. Pl. XXI. fig. 24.
3. „ *P. Great Barrier Reef 36*; „ Pl. XXI. fig. 25.
4. „ *P. Great Barrier Reef 37*; „ Pl. XXI. fig. 26.
5. „ *P. Great Barrier Reef 38*; „ Pl. XXI. fig. 27.
6. „ *P. Great Barrier Reef 39*; „ Pl. XXI. fig. 28.
7. „ *P. Great Barrier Reef 40*; „ Pl. XX. fig. 3.
8. „ *P. Great Barrier Reef 41*; „ Pl. XX. fig. 4.
9. „ *P. Great Barrier Reef 42*; „ Pl. XX. fig. 5.

PLATE XIX.

1. Growth-forms of *P. Great Barrier Reef 3*, × $\frac{4}{5}$; for the calicles, cf. Pl. XIV. fig. 3.
2. „ *P. Great Barrier Reef 4*, × $\frac{5}{6}$; „ Pl. XIV. fig. 4.
3. „ *P. Great Barrier Reef 5*, × $\frac{3}{5}$; „ Pl. XIV. fig. 5.
4. „ *P. Great Barrier Reef 6*, × $\frac{1}{2}$; „ Pl. XIV. fig. 6.
5. „ *P. Great Barrier Reef 9*, × $\frac{3}{4}$; „ Pl. XIV. fig. 9.
6. „ *P. Great Barrier Reef 12*, × $\frac{3}{4}$.
7. „ *P. Great Barrier Reef 10*, × $\frac{4}{5}$; for the calicles, cf. Pl. XV. fig. 1; the dark spots indicating the calicles are not pits, but are due to the orange tinge of the aperture.
8. „ *P. Great Barrier Reef 11*, × $\frac{3}{5}$; for the calicles, cf. Pl. XV. fig. 2.
9. „ *P. Great Barrier Reef 17*, × $\frac{2}{3}$; „ Pl. XV. fig. 7.

PLATE XX.

1. Growth-form of *P. Great Barrier Reef 16*, × $\frac{1}{2}$; for the calicles, cf. Pl. XVI. figs. 8 and 9.
2. „ *P. Great Barrier Reef 19*, × $\frac{1}{2}$; „ Pl. XV. fig. 9.
3. „ *P. Great Barrier Reef 40*, × $\frac{2}{3}$; „ Pl. XVIII. fig. 7.
4. „ *P. Great Barrier Reef 41*, × $\frac{2}{3}$; „ Pl. XVIII. fig. 8.
5. „ *P. Great Barrier Reef 42*, × $\frac{1}{2}$; „ Pl. XVIII. fig. 9.

PLATE XXI.

LITHOGRAPHIC REPRESENTATIONS OF GROWTH-FORMS.

With approximate reductions.

1. Growth-form of *P. Great Barrier Reef 1*, × $\frac{1}{2}$; for the calicles, cf. Pl. XIV. fig. 1.
2. „ *P. Great Barrier Reef 2*, × $\frac{1}{2}$; „ Pl. XIV. fig. 2.
3. „ *P. Great Barrier Reef 7*, × $\frac{1}{2}$; „ Pl. XIV. fig. 7.
4. „ *P. Great Barrier Reef 8*, × $\frac{1}{2}$; „ Pl. XIV. fig. 8.
5. „ *P. Great Barrier Reef 13*, × $\frac{1}{2}$; „ Pl. XV. fig. 3.

PLATE XXI.—*continued.*

FIG.

6. Growth-form of specimen *b* of *P. Great Barrier Reef 14*, × ⅓; for the calicles, cf. Pl. XV. fig. 4.
7. „ specimen *a* of *P. Great Barrier Reef 14*, × ½.
8. „ *P. Great Barrier Reef 6*, × ½; for the calicles, cf. Pl. XIV. fig. 6.
9. „ *P. Great Barrier Reef 16*, × ½; „ Pl. XV. fig. 1.
10. „ *P. Great Barrier Reef 20*, × ½; „ Pl. XVI. fig. 1.
11. „ *P. Great Barrier Reef 22*, × ½; „ Pl. XVI. fig. 3.
12. „ *P. Great Barrier Reef 15*, × ½; „ Pl. XV. fig. 5.
13. „ *P. Great Barrier Reef 23*, × ⅓; „ Pl. XVI. fig. 4.
14. „ *P. Great Barrier Reef 24*, × ½; „ Pl. XVI. fig. 5.
15. „ *P. Great Barrier Reef 27*, × ½; „ Pl. XVII. fig. 1.
16. „ *P. Great Barrier Reef 26*, × ⅓; „ Pl. XVI. figs. 8 and 9.
17. „ *P. Great Barrier Reef 25*, × ½; „ Pl. XVI. figs. 6 and 7.
18. „ specimen *b* of *P. Great Barrier Reef 28*, × ⅓; for the calicles, cf. Pl. XVII. fig. 2.
19. „ specimen *a* of the same, × ⅓.
20. „ *P. Great Barrier Reef 31*, × ½; for the calicles, cf. Pl. XVII. fig. 7.
21. „ *P. Great Barrier Reef 29*, × ⅓; „ Pl. XVII. figs. 3, 4, 5.
22. „ *P. Great Barrier Reef 30*, × ⅓; „ Pl. XVII. fig. 6.
23. „ *P. Great Barrier Reef 32*, × ½; „ (? part of spec. 28) Pl. XVII. fig. 8.
24. „ *P. Great Barrier Reef 35*, × ⅓; „ Pl. XVIII. fig. 2.
25. „ *P. Great Barrier Reef 36*, × ½; „ Pl. XVIII. fig. 3.
26. „ *P. Great Barrier Reef 37*, × ⅓; „ Pl. XVIII. fig. 4.
27. „ *P. Great Barrier Reef 38*, × ½; „ Pl. XVIII. fig. 5.
28. „ *P. Great Barrier Reef 39*, × ⅓; „ (? part of spec. 32) Pl. XVIII. fig. 6.

PLATE XXII.

1. From *P. North-East Australia 1.*
2. „ *P. North Australia 1*; for growth-form, cf. Pl. XXIV. fig. 1.
3. „ *P. North Australia 2*; „ Pl. XXIV. fig. 5.
4. „ *P. North Australia 3*; „ Pl. XXXV. fig. 14.
5. „ *P. North Australia 4*; „ Pl. XXIV. fig. 3.
6. „ *P. North Australia 5*; „ Pl. XXIV. fig. 7.
7. „ *P. North Australia 6*; „ Pl. XXIV. fig. 2.
8. „ *P. North Australia 7*; „ Pl. XXIV. fig. 6.
9. „ *P. North Australia 8*; „ Pl. XXIV. fig. 4.

PLATE XXIII.

FIG.
1. From *P. North-West Australia 1.*
2. „ *P. North-West Australia 2*; for growth-form, cf. Pl. XXXV. fig. 2.
3 and 4. From *P. North-West Australia 3.*
5. From *P. North-West Australia 4*; for growth-form, cf. Pl. XXXV. fig. 1.
6. „ *P. North-West Australia 5*; „ Pl. XXXV. fig. 3.
7. „ *P. North-West Australia 6*; „ Pl. XXXV. fig. 4.
8. „ *P. North-West Australia 7.*
9. „ *P. North-West Australia 8*; for growth-form, cf. Pl. XXXV. fig. 5.

PLATE XXIV.

1. Growth-form of *P. North Australia 1*, × $\frac{1}{3}$; for the calicles, cf. Pl. XXII. fig. 2.
2. „ *P. North Australia 6*, × $\frac{2}{3}$; „ Pl. XXII. fig. 7.
3. „ *P. North Australia 4*, × $\frac{1}{2}$; „ Pl. XXII. fig. 5.
4. „ *P. North Australia 8*, × $\frac{3}{5}$; „ Pl. XXII. fig. 9.
5. „ *P. North Australia 2*, × $\frac{1}{2}$; „ Pl. XXII. fig. 3.
6. „ *P. North Australia 7*, × $\frac{1}{2}$; „ Pl. XXII. fig. 8.
7. „ *P. North Australia 5*, × $\frac{1}{3}$; „ Pl. XXII. fig. 6.

PLATE XXV.

1 and 2. Upper and lower calicles from *P. Timor-laut 1*; for growth-form, cf. Pl. XXXV. fig. 6.
3. From *P. Banda Sea 1*; for growth-form, cf. Pl. XXXV. fig. 7.
4. „ *P. Banda Sea 2.*
5. „ *P. Philippines 1.*
6. „ *P. Philippines 5*; for growth-form, cf. Pl. XXXV. fig. 8.
7. „ *P. Philippines 6.*
8. „ *P. Philippines 6.*
9. „ *P. China Sea 3.*

PLATE XXVI.

1. From *P. China Sea 4*; for growth-form (specimen *a*), cf. Pl. XXXV. fig. 9.
2. Section of the same, showing the absence of continuous vertical trabeculæ.
3. Creeping edge of this small colony from depth of 23–40 fathoms (? young form).
4. From *P. China Sea 5.*
5. „ *P. China Sea 6.*
6. „ *P. China Sea 7.*
7. „ *P. China Sea 8.*
8. „ *P. China Sea 9.*
9. „ *P. China Sea 10*; for growth-form, cf. Pl. XXXV. fig. 10.

PLATE XXVII.

FIG.
1. From *P. China Sea 11.*
2. „ *P. China Sea 12.*
3. „ *P. China Sea 13*; for growth-form, cf. Pl. XXXV. fig. 11.
4. „ *P. China Sea 14*; „ Pl. XXXV. fig. 13.
5. „ *P. China Sea 15*; „ Pl. XXXV. fig. 27.
6. „ *P. China Sea 16*; „ Pl. XXXV. fig. 16.
7. „ *P. China Sea 17*; „ Pl. XXXV. fig. 18.
8. „ *P. China Sea 18*; „ Pl. XXIX. fig. 3.
9. „ *P. China Sea 19.*

PLATE XXVIII.

1. From *P. Singapore 1*; for growth-form, cf. Pl. XXXV. fig. 19.
2. „ *P. Singapore 2*; „ Pl. XXXV. fig. 24.
3. „ *P. Singapore 3*; „ Pl. XXXV. fig. 15.
4. „ *P. Singapore 4*; „ Pl. XXXV. fig. 21.
5. „ *P. Singapore 5*; *a*, from the top of the column; *b*, from the side of same, near the top; for growth-form, cf. Pl. XXIX. fig. 4.
6. „ *P. Singapore 6*; for growth-form, cf. Pl. XXIX. fig. 5.
7. „ *P. Singapore 7*; „ Pl. XXIX. fig. 1.
8. „ *P. Java Sea 2*; „ Pl. XXIX. fig. 2.
9. „ *P. Christmas Island 1.*

PLATE XXIX.

1. Growth-form of *P. Singapore 7*, × $\frac{1}{3}$; for the calicles, cf. Pl. XXVIII. fig. 7.
2. „ *P. Java Sea 2*, × $\frac{1}{6}$; „ Pl. XXVIII. fig. 8.
3. „ *P. China Sea 18*, × $\frac{3}{5}$; „ Pl. XXVII. fig. 8.
4. „ *P. Singapore 5*, × $\frac{1}{3}$; „ Pl. XXVIII. fig. 5, *a* and *b*.
5. „ *P. Singapore 6*, × $\frac{1}{2}$; „ Pl. XXVIII. fig. 6.

PLATE XXX.

1. From *P. Kokos Islands 1.*
2. „ *P. Ceylon 7*; for growth-form, cf. Pl. XXXV. fig. 22.
3. „ *P. Ceylon 2*; „ Pl. XXXV. fig. 30.
4. „ *P. Ceylon 3.*
5. „ *P. Ceylon 4*; for growth-form, cf. Pl. XXXV. fig. 31.
6. „ *P. Ceylon 5.*
7. „ *P. Ceylon 6.*
8. „ *P. Ceylon 1*; for growth-form, cf. Pl. XXXV. fig. 29.
9. „ *P. Ceylon 8.*

PLATE XXXI.

FIG.
1. From *P. Ceylon 9.*
2. „ *P. Ceylon 10.*
3. „ *P. Ceylon 12*; for growth-form, cf. Pl. XXXV. fig. 17.
4. „ *P. Ceylon 13*; „ Pl. XXXV. fig. 23.
5. „ *P. Ceylon 16.*
6. „ *P. Ceylon 18.*
7. „ *P. Maldives 1.*
8. „ *P. Maldives 2*; for growth-form, cf. Pl. XXXIV. fig. 3.
9. „ *P. Maldives 3*; the calicles of a creeping edge; for the growth-form, cf. Pl. XXXIV. fig. 7.

PLATE XXXII.

1. From *P. Diego Garcia 1.*
2. „ *P. Diego Garcia 2.*
3. „ *P. Diego Garcia 3*; for growth-form, cf. Pl. XXXIV. fig. 4.
4. „ *P. Rodriguez 1.*
5. „ *P. Rodriguez 2*; for growth-form, cf. Pl. XXXV. fig. 28.
6. „ *P. Mauritius 1.*
7. „ *P. Mauritius 3*; for growth-form, cf. Pl. XXXIV. fig. 5.
8. „ *P. Mauritius 4*; „ Pl. XXXIV. fig. 2.
9. „ *P. Mauritius 5*; „ Pl. XXXIV. fig. 1.

PLATE XXXIII.

1. From *P. Amirantes 1.*
2. „ *P. Amirantes 2.*
3. „ *P. Amirantes 3*; for growth-form, cf. Pl. XXXV. fig. 26.
4. „ *P. Providence Island 1*; for growth-form, cf. Pl. XXXV. fig. 25.
5. „ *P. Providence Island 2*; „ Pl. XXXV. fig. 12.

6*a*. „ specimen *a* of *P. Persian Gulf 1.*

6*b*. „ specimen *f* of same; for growth-form, cf. Pl. XXXIV. fig. 6.

7. „ specimen in British Museum of *P. Red Sea 1.*

8*a*–*b*. From top and side, low down, of the British Museum specimen of *P. Red Sea 2.*

9. From *P. Red Sea 5.*

PLATE XXXIV.

1. Growth-form of *P. Mauritius 5*, × $\frac{1}{3}$; for the calicles, cf. Pl. XXXII. fig. 9.
2. „ *P. Mauritius 4*, × $\frac{1}{4}$; „ Pl. XXXII. fig. 8.
3. „ *P. Maldives 2*, × $\frac{1}{4}$; „ Pl. XXXI. fig. 8.
4. „ *P. Diego Garcia 3*, × $\frac{1}{3}$; „ Pl. XXXII. fig. 3.
5. „ *P. Mauritius 3*, × $\frac{1}{3}$; „ Pl. XXXII. fig. 7.
6. „ *P. Persia 1*, specimen *f*, × $\frac{3}{5}$; „ Pl. XXXIII. fig. 6*a* and *b*.
7. „ *P. Maldives 3*, × $\frac{1}{5}$; „ Pl. XXXI. fig. 9.

PLATE XXXV.

LITHOGRAPHIC REPRESENTATIONS OF GROWTH-FORMS.

With approximate reductions.

FIG.

1. *P. North-West Australia 4*, × $\frac{1}{4}$; for the calicles, cf. Pl. XXIII. fig. 5.
2. *P. North-West Australia 2*, × $\frac{1}{2}$; „ Pl. XXIII. fig. 2.
3. *P. North-West Australia 5*, × $\frac{1}{3}$; „ Pl. XXIII. fig. 6.
4. *P. North-West Australia 6*, × $\frac{1}{3}$; „ Pl. XXIII. fig. 7.
5. *P. North-West Australia 8*, × $\frac{1}{2}$; „ Pl. XXIII. fig. 9.
6. *P. Timor-laut 1*, × $\frac{1}{4}$; „ Pl. XXV. figs. 1 and 2.
7. *P. Banda Sea 1*, × $\frac{1}{3}$; „ Pl. XXV. fig. 3.
8. *P. Philippines 5*, × $\frac{1}{4}$; „ Pl. XXV. fig. 6.
9. *P. China Sea 4*, × $\frac{1}{5}$; „ Pl. XXVI. figs. 1, 2 and 3.
10. *P. China Sea 10*, × $\frac{1}{3}$; „ Pl. XXVI. fig. 9.
11. *P. China Sea 13*, × $\frac{1}{6}$; „ Pl. XXVII. fig. 3.
12. *P. Providence Island 2*, × $\frac{1}{3}$; „ Pl. XXXIII. fig. 5.
13. *P. China Sea 14*, × $\frac{1}{4}$; „ Pl. XXVII. fig. 4.
14. *P. North Australia 3*, × $\frac{1}{3}$; „ Pl. XXII. fig. 4.
15. *P. Singapore 3*, × $\frac{1}{4}$; „ Pl. XXVIII. fig. 3.
16. *P. China Sea 16*, × $\frac{1}{3}$; „ Pl. XXVII. fig. 6.
17. *P. Ceylon 12*, × $\frac{1}{3}$; „ Pl. XXXI. fig. 3.
18. *P. China Sea 17*, × $\frac{1}{4}$; „ Pl. XXVII. fig. 7.
19. *P. Singapore 1*, × $\frac{1}{8}$; „ Pl. XXVIII. fig. 1.
20. *P. Persian Gulf 2*, × $\frac{1}{4}$.
21. *P. Singapore 4*, × $\frac{1}{3}$; for the calicles, cf. Pl. XXVIII. fig. 4.
22. *P. Ceylon 7*, × $\frac{1}{6}$; „ Pl. XXX. fig. 2.
23. *P. Ceylon 13*, × $\frac{1}{2}$; „ Pl. XXXI. fig. 4.
24. *P. Singapore 2*, × $\frac{1}{3}$; „ Pl. XXVIII. fig. 2.
25. *P. Providence Island 1*, × $\frac{1}{3}$; „ Pl. XXXIII. fig. 4.
26. *P. Amirantes 3*, × $\frac{1}{4}$; „ Pl. XXXIII. fig. 3.
27. *P. China Sea 15*, × $\frac{1}{6}$; „ Pl. XXVII. fig. 5.
28. *P. Rodriguez 2*, × $\frac{1}{3}$; „ Pl. XXXII. fig. 5.
29. *P. Ceylon 1*, × $\frac{1}{7}$; „ Pl. XXX. fig. 8.
30. *P. Ceylon 2*, × $\frac{1}{7}$; „ Pl. XXX. fig. 3.
31. *P. Ceylon 4*, × $\frac{1}{7}$; „ Pl. XXX. fig. 5.

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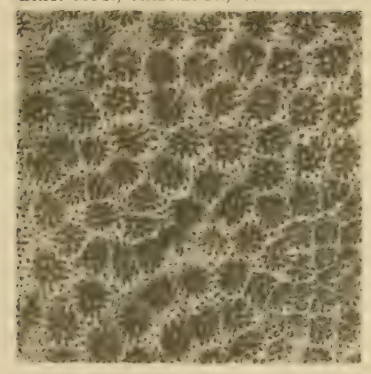

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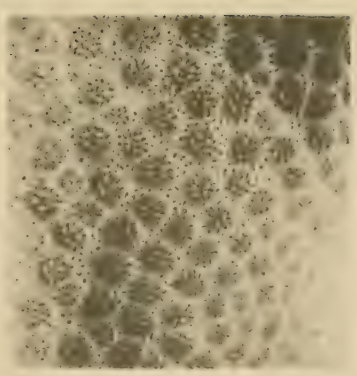

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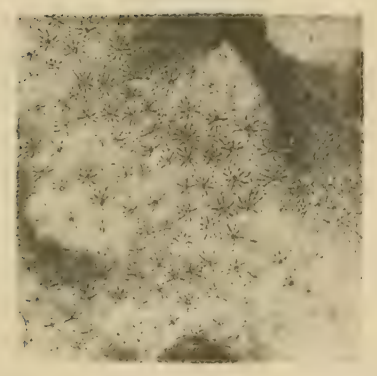

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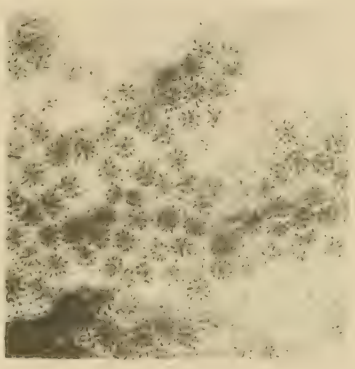

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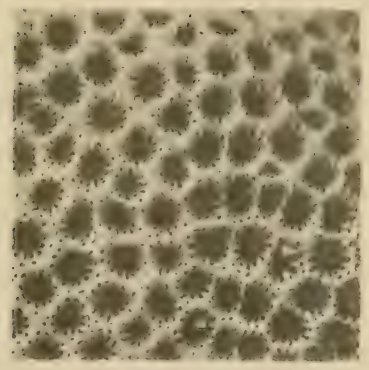

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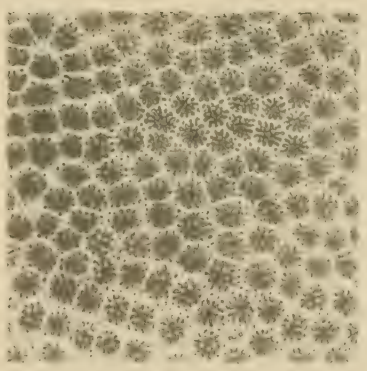


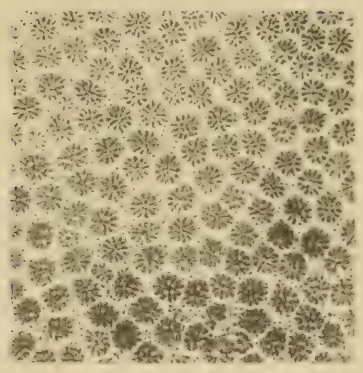
9

PORITES.

PACIFIC AREA.

1—5, Society Islands. 6, Samoa. 7—9, Tonga Islands.

Collo: Morgan & Kidd, Richmond, S.W.



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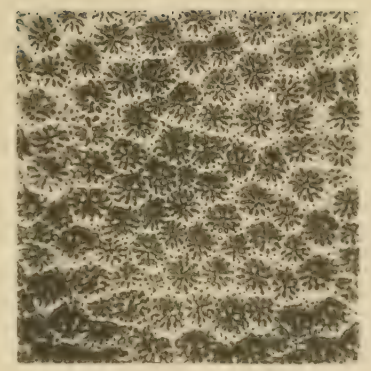

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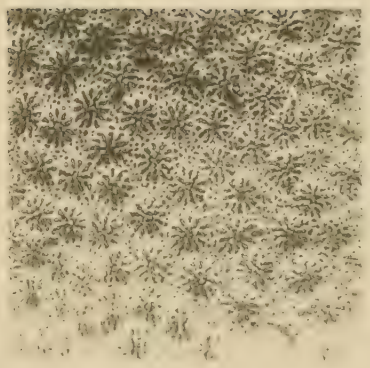

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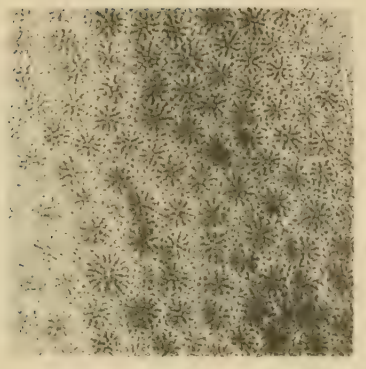

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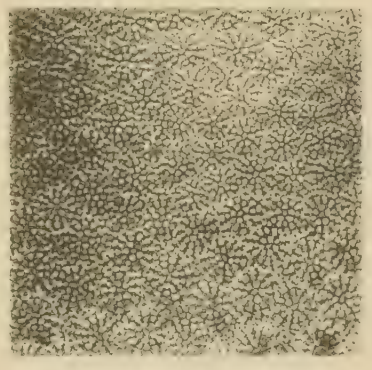

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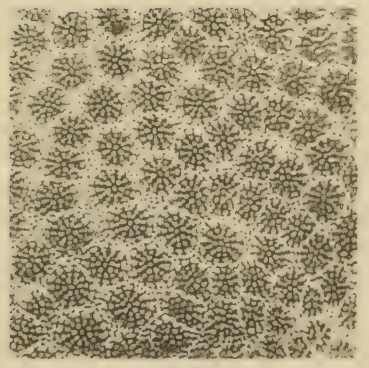

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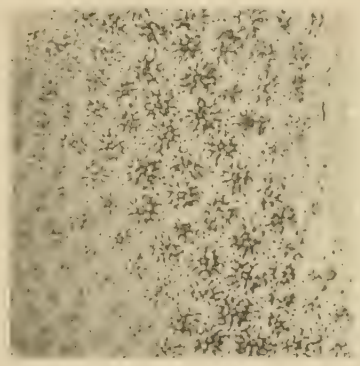

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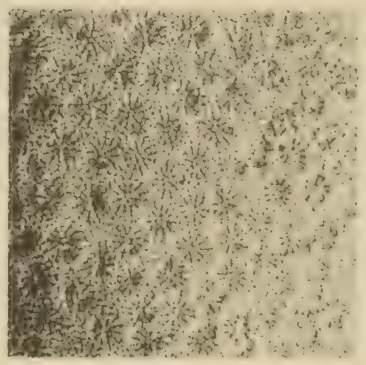

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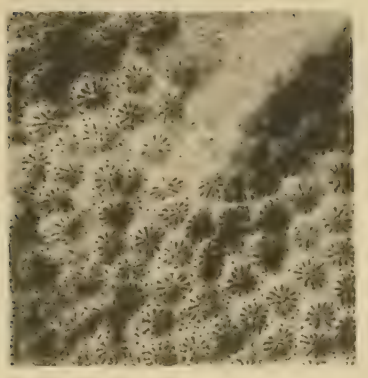
PORITES.

PACIFIC AREA.

1—8, Tonga Islands. 9, Fiji Islands.

Collo: Morgan & Kidd, Richmond, S.W.



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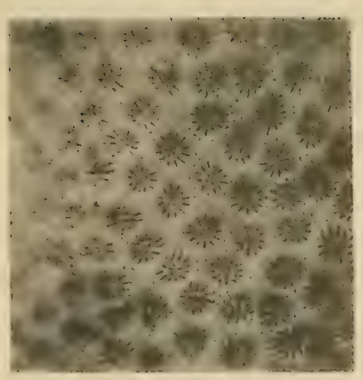

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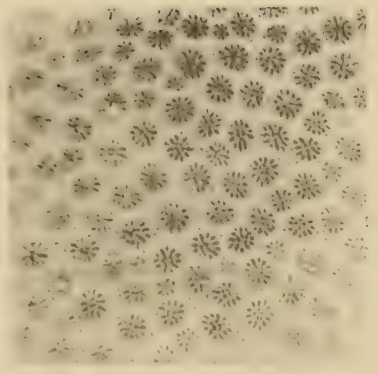

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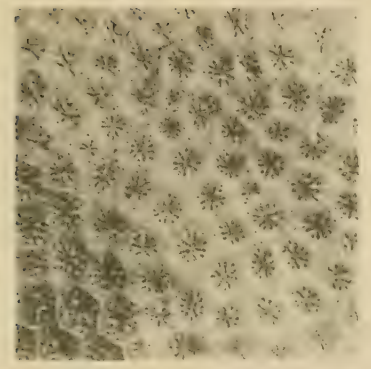

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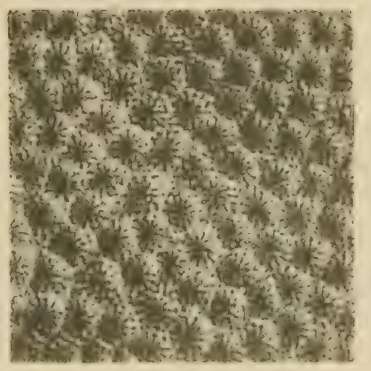

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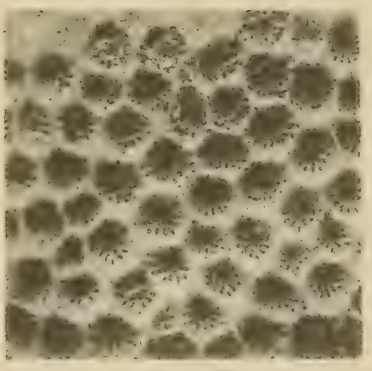

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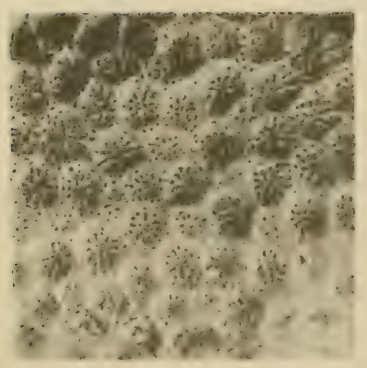

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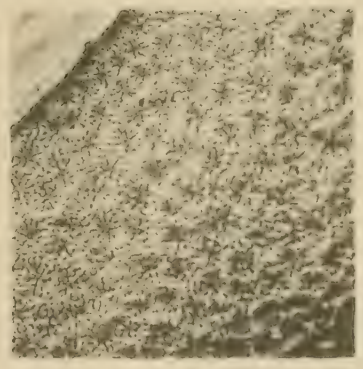

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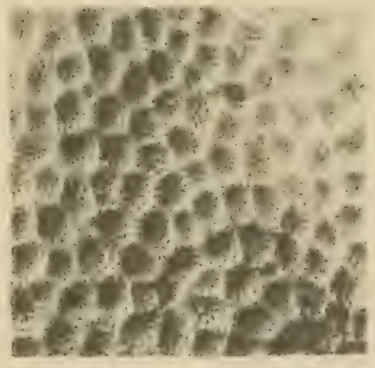

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PORITES.

PACIFIC AREA.

Fiji Islands.

Collo: Morgan & Kidd, Richmond, S.W.

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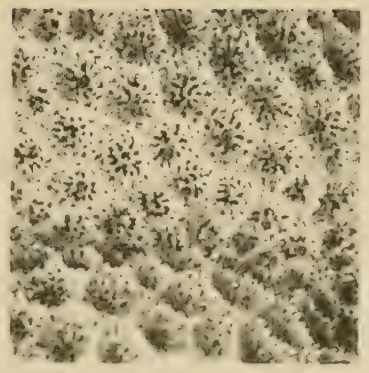

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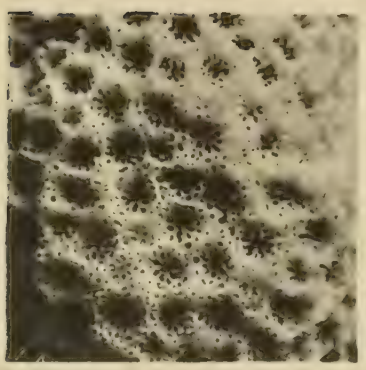

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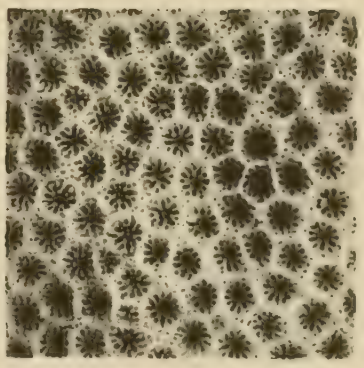

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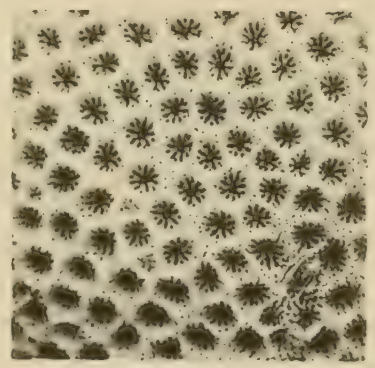

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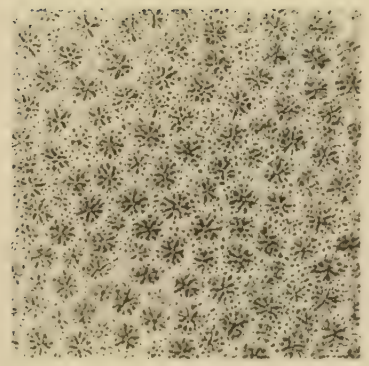

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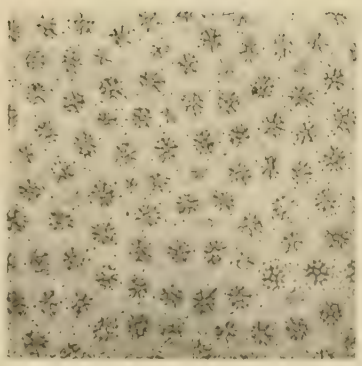

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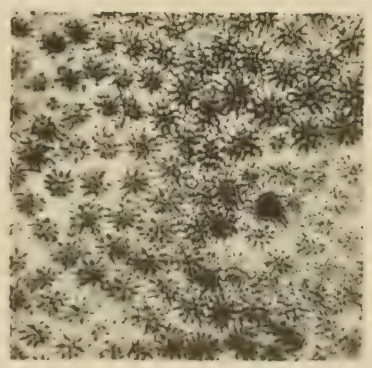


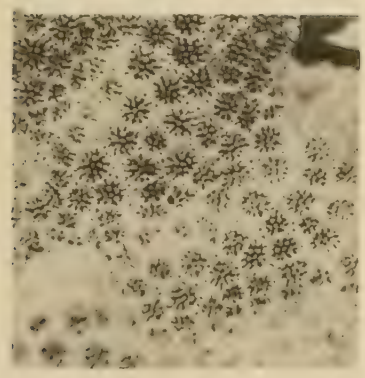
9

PORITES.

PACIFIC AREA.

Fiji Islands.

Collo: Morgan & Kidd, Richmond, S.W.



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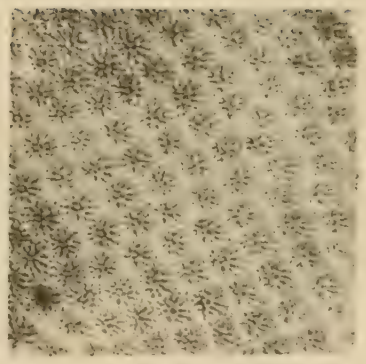

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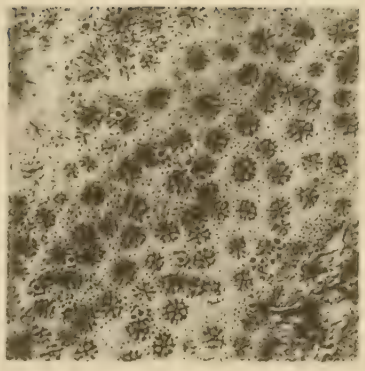

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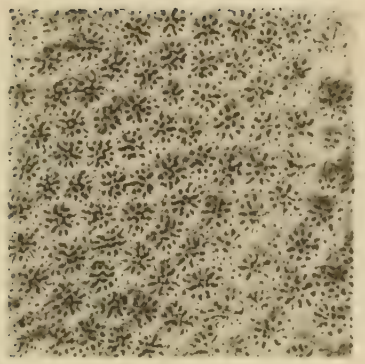

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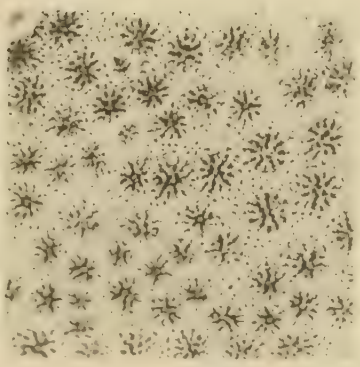

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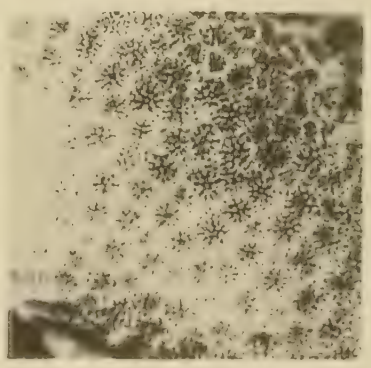

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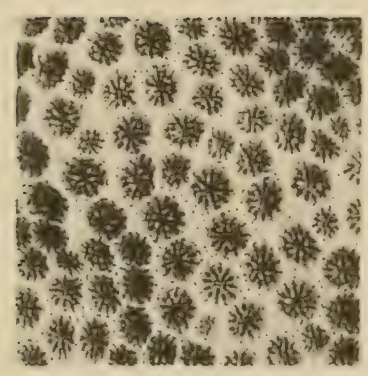

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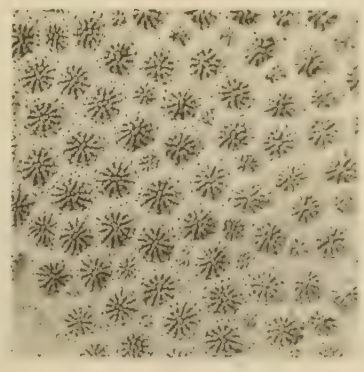

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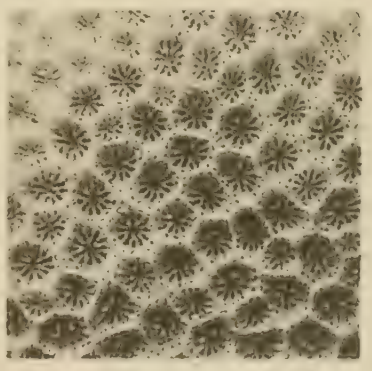


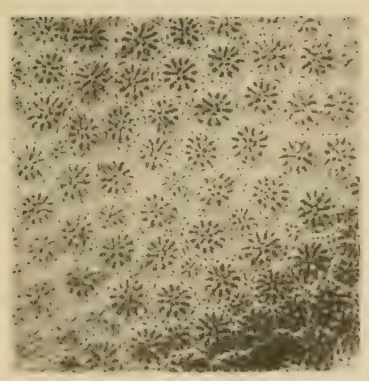
9

PORITES

PACIFIC AREA.

1, Fiji Islands, 2—9, Ellice Islands.

Collo: Morgan & Kidd, Richmond, S.W.



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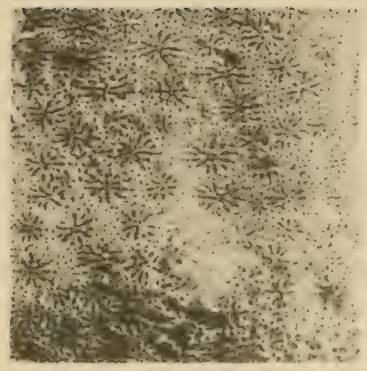

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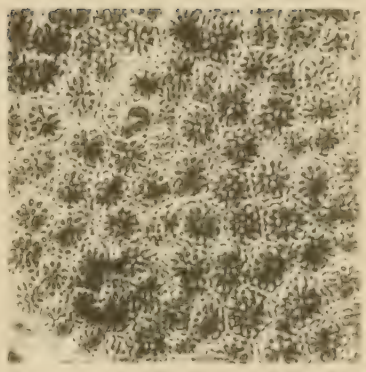

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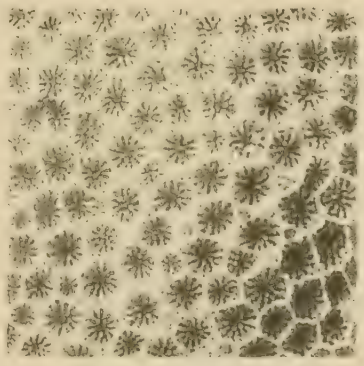

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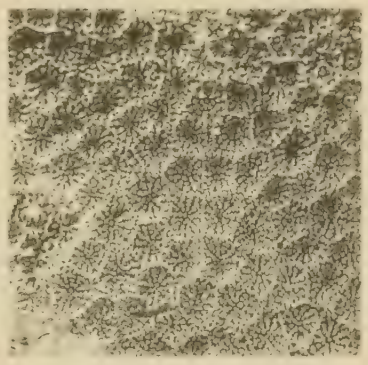

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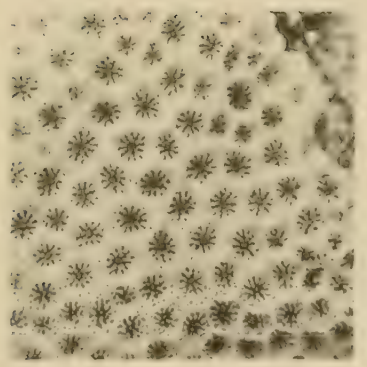

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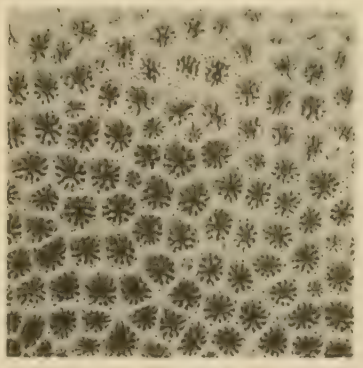

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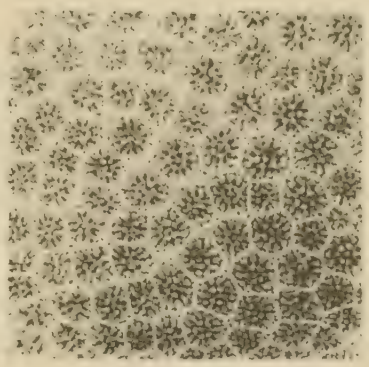


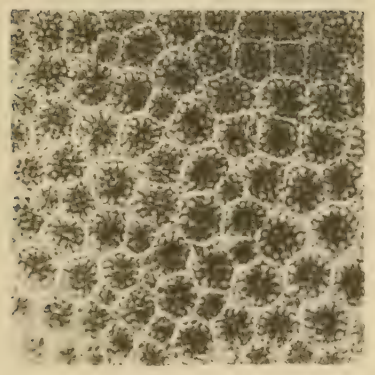
9

PORITES.

PACIFIC AREA.

Ellice Islands.

Collo: Morgan & Kidd, Richmond, S.W.



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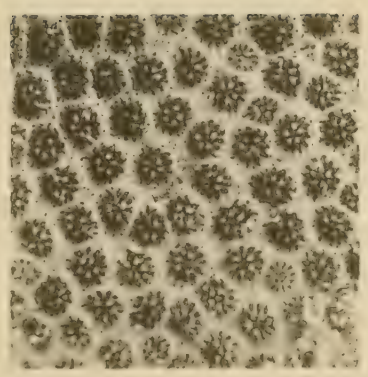

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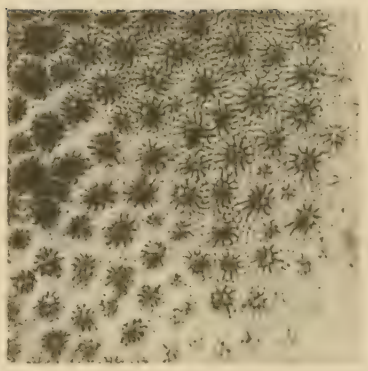

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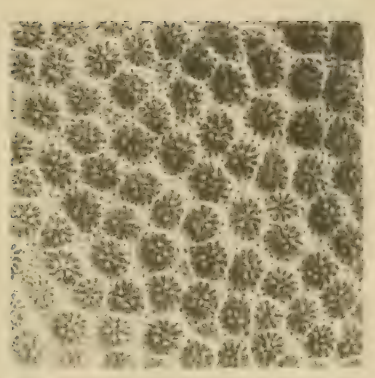

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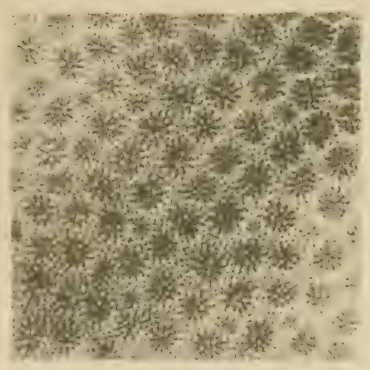

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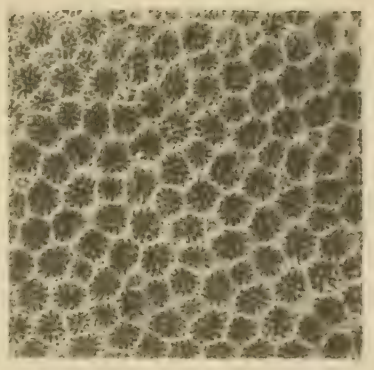

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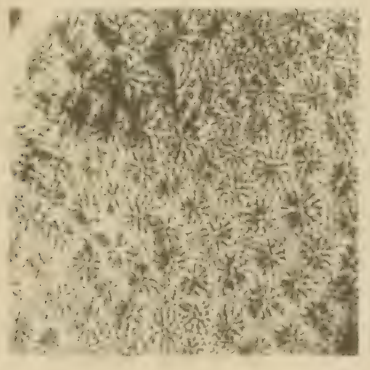

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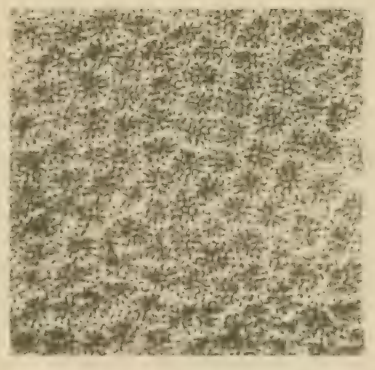


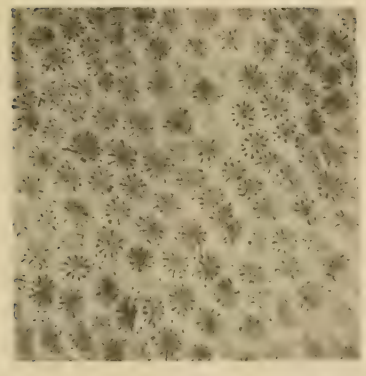
9

PORITES.

PACIFIC AREA.

Ellice Islands.

Collo: Morgan & Kidd, Richmond, S.W.



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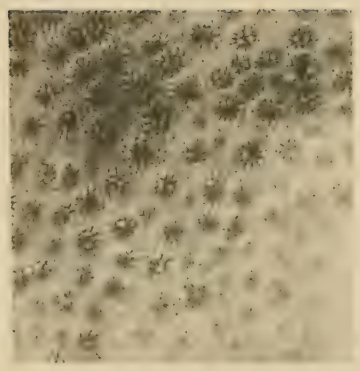

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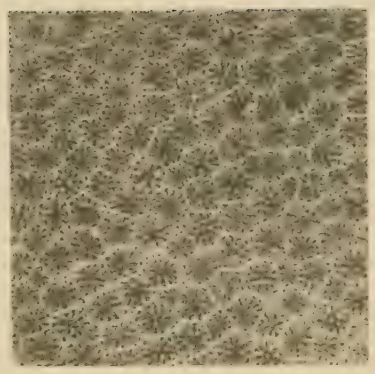

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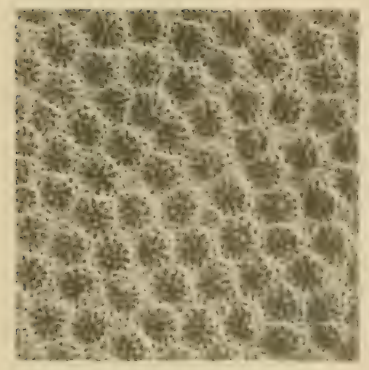

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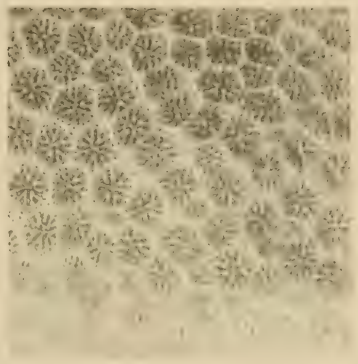

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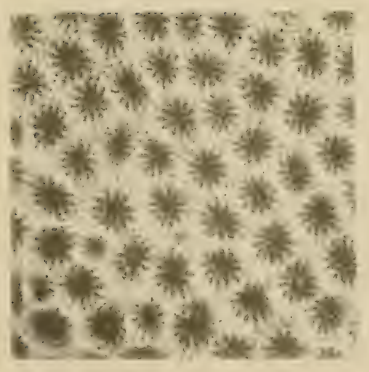

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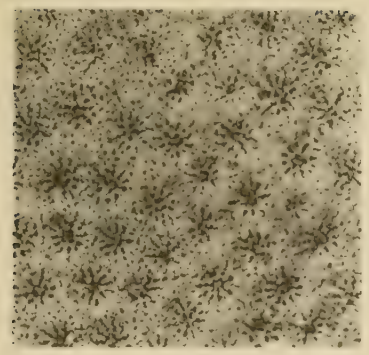
9

PORITES.

PACIFIC AREA.

New Hebrides. 2—9, Solomon Islands.

Collo: Morgan & Kidd, Richmond, S.W.



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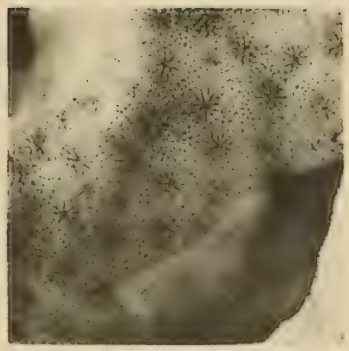

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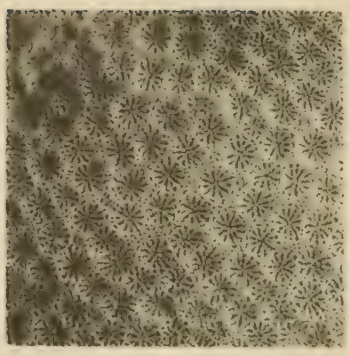

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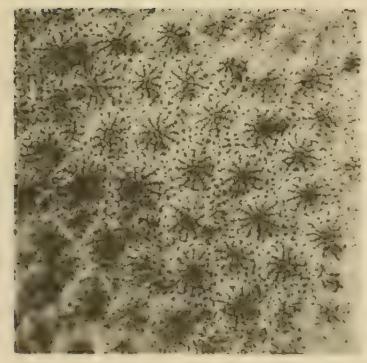

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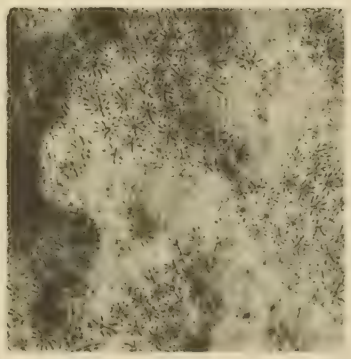

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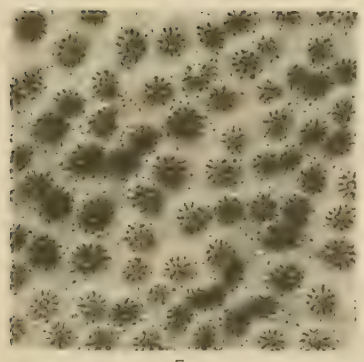

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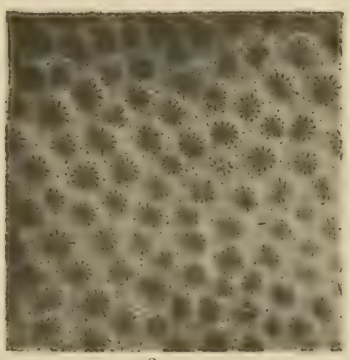

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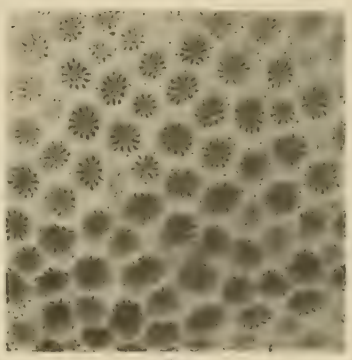


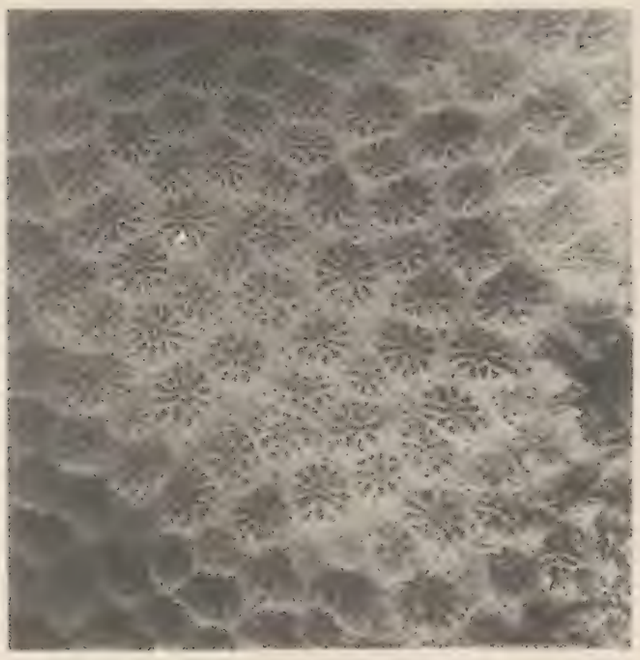
9

PORITES.

PACIFIC AREA.

1-2. Solomon Islands. 3-4. New Guinea. 5-7. Caroline Islands. 8.9 Sandwich Islands.

Collo Morgan & Kidd Richmond, S.W.



1

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PORITES.

PACIFIC AREA.

1-2. Sandwich Islands. 3. Bay of Panama. 4-7. Growth-forms.

Collo : Morgan & Kidd, Richmond, S.W.

1

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PORITES.

GROWTH-FORMS FROM THE PACIFIC AREA.

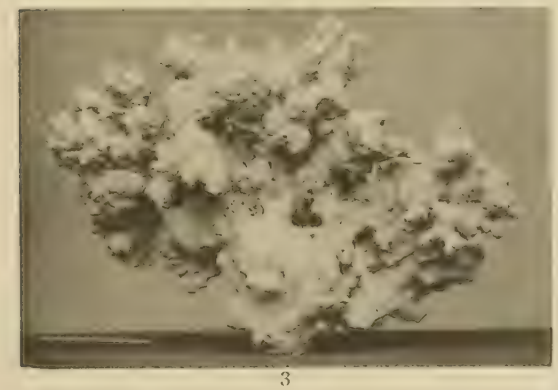
Collo: Morgan & Kidd, Richmond, S.W.

1

4

2

5



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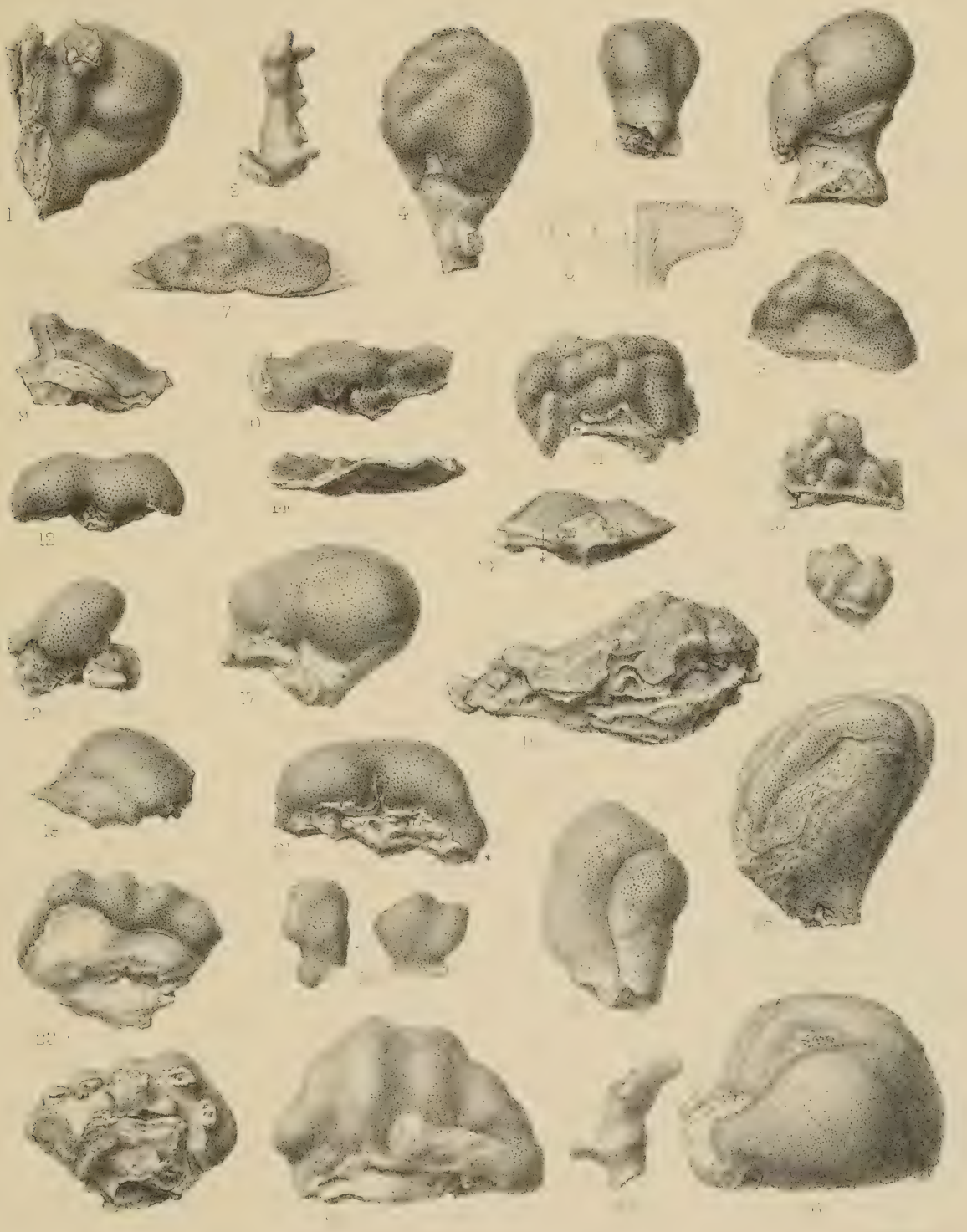
6

PORITES.

GROWTH-FORMS FROM THE PACIFIC AREA.

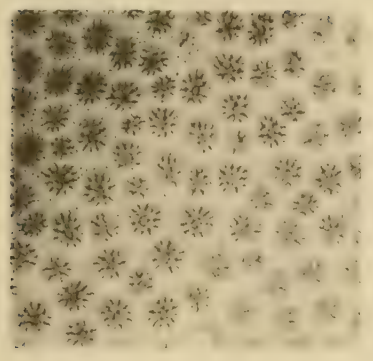
Collo: Morgan & Kidd, Richmond, S.W.



A.T.Hollick del.et lith.

PORITES.

GROWTH-FORMS FROM THE PACIFIC AREA



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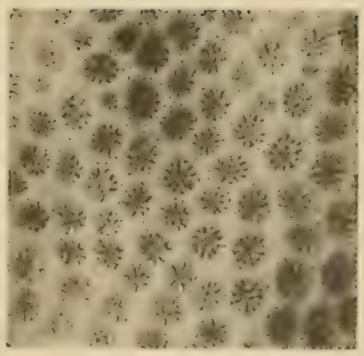

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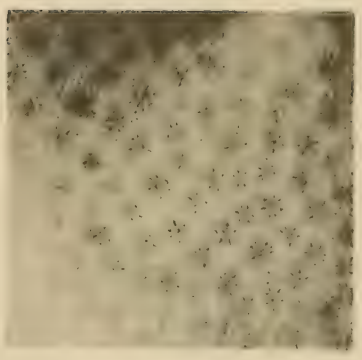

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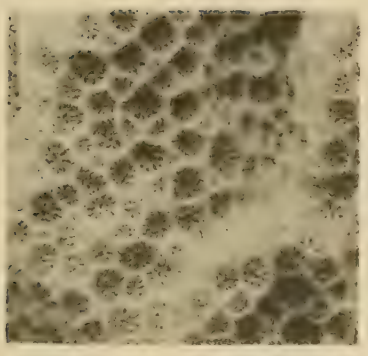

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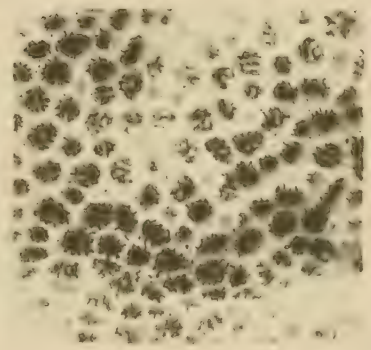

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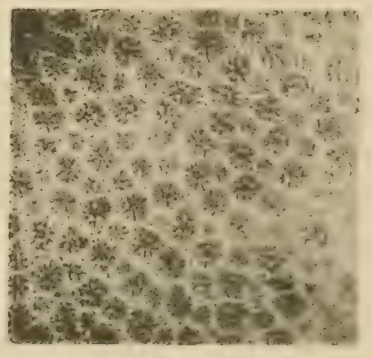

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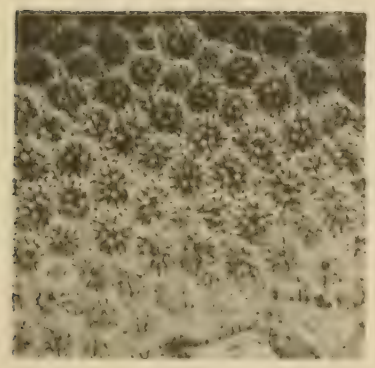

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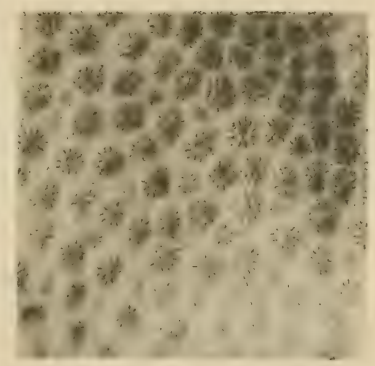

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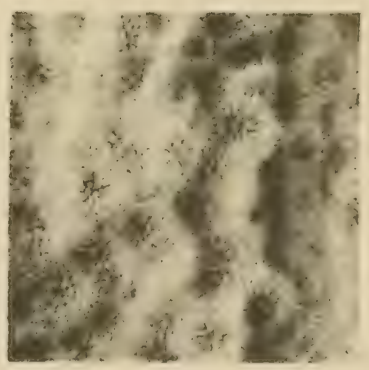
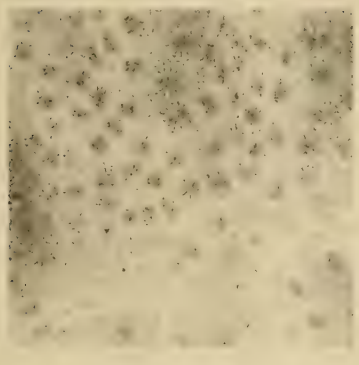


9

PORITES.

GREAT BARRIER REEF

Collo Morgan & Kidd Richmond, S.W.



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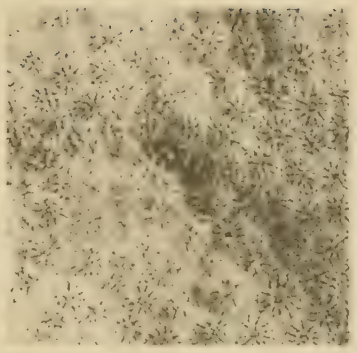

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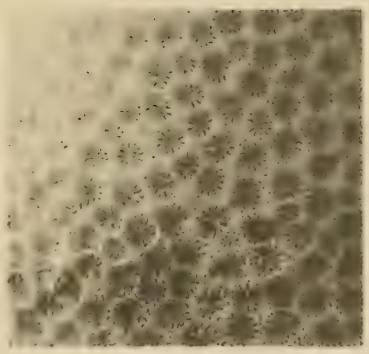

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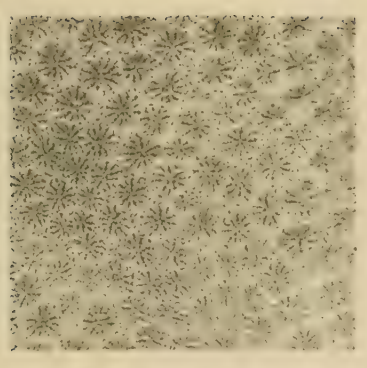

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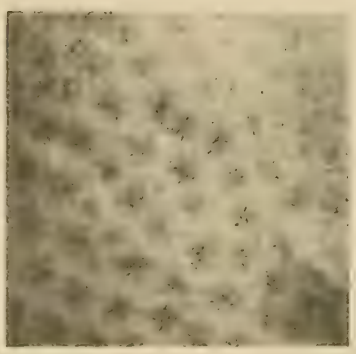

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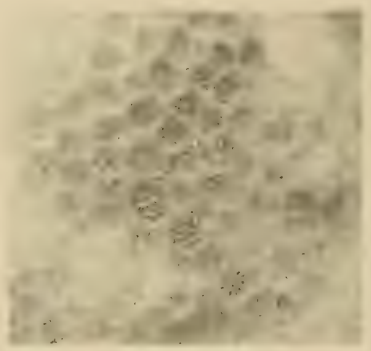

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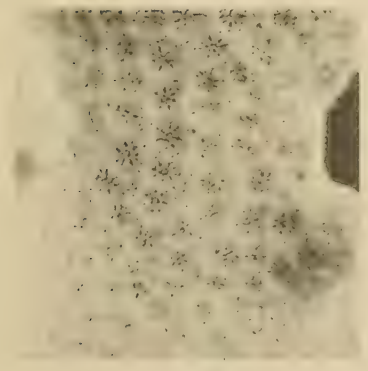

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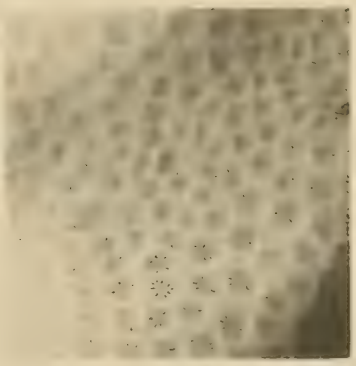

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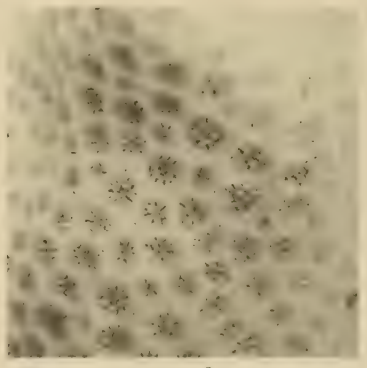
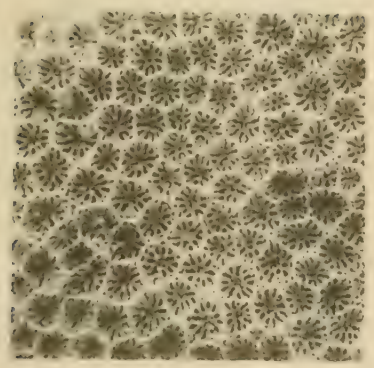


9

PORITES.

GREAT BARRIER REEF.

Collo · Morgan & Kidd. Richmond, S.W.



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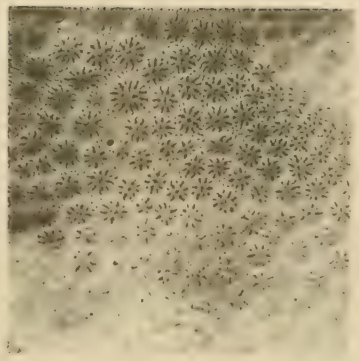

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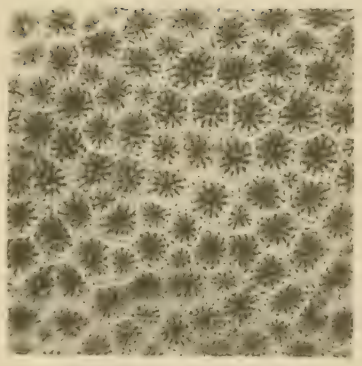

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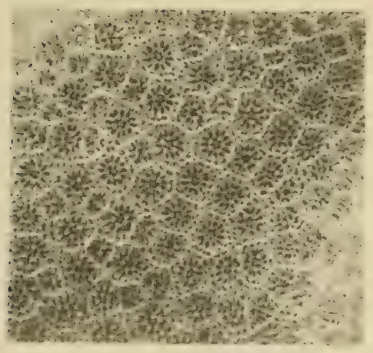

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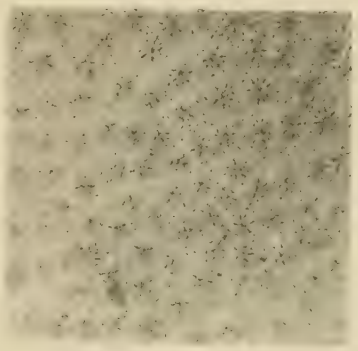

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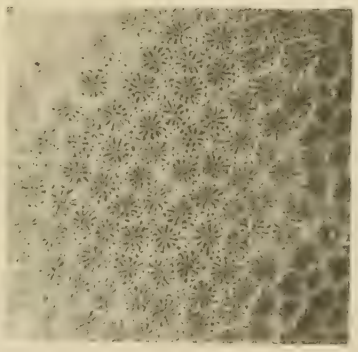

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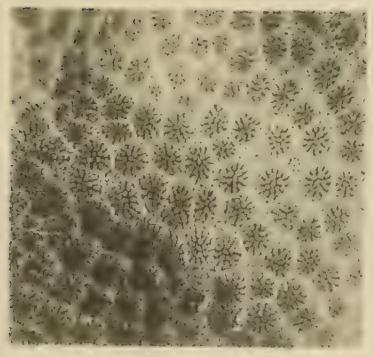

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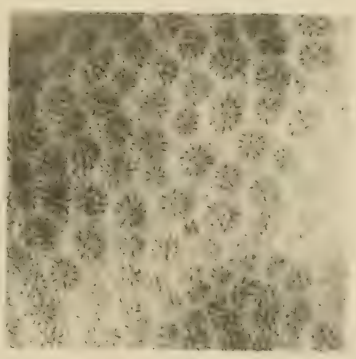

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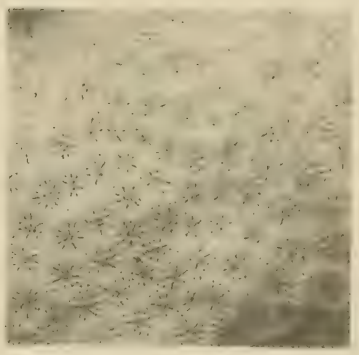
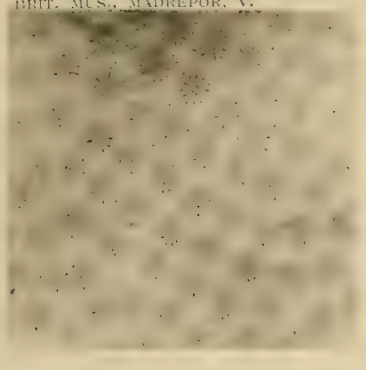


9

PORITES.

GREAT BARRIER REEF.

Collo: Morgan & Kidd, Richmond, S.W.



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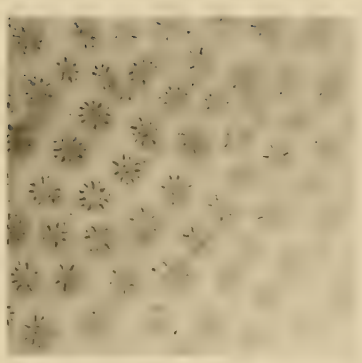

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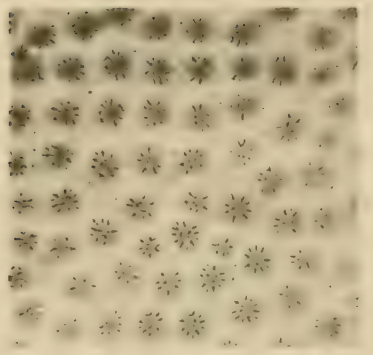

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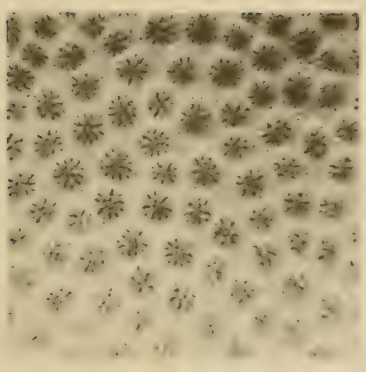

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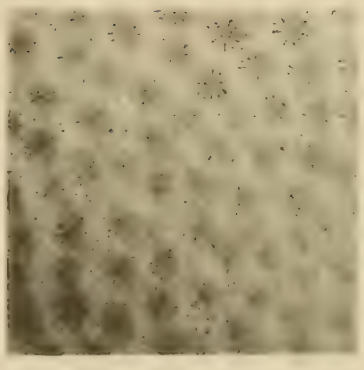

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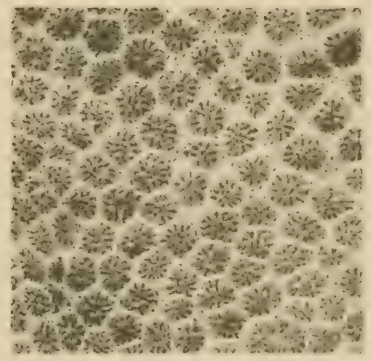

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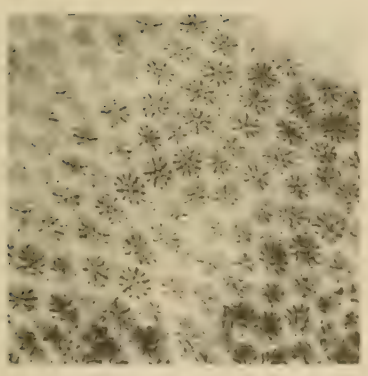

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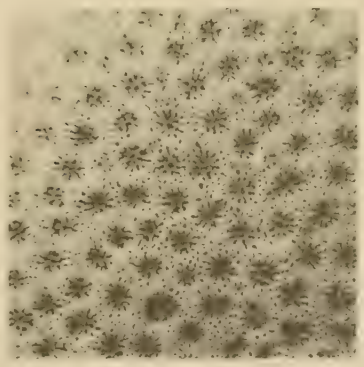

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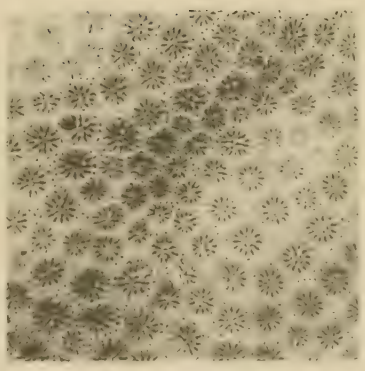
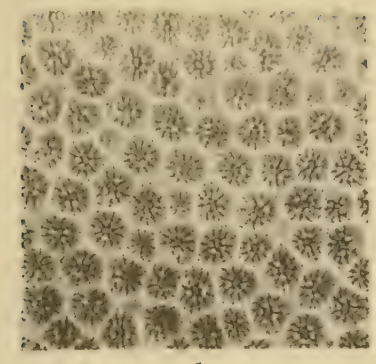


9

PORITES.

GREAT BARRIER REEF

Collo: Morgan & Kidd, Richmond, S.W.



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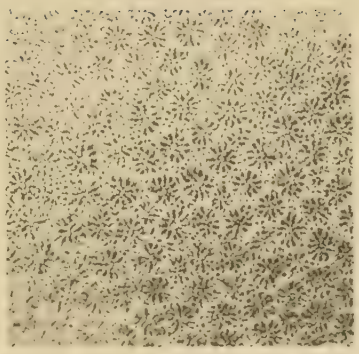

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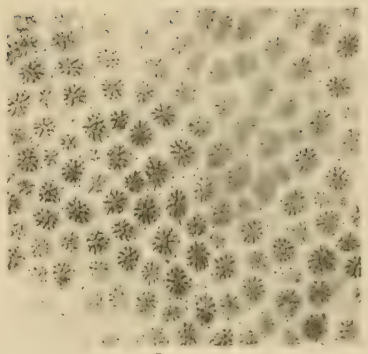

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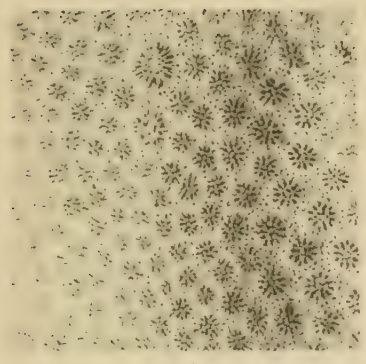

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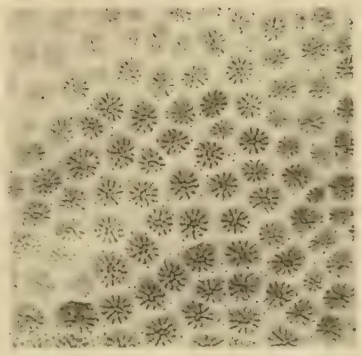

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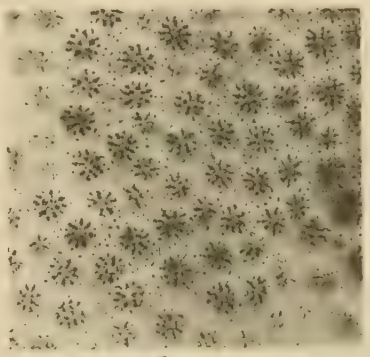

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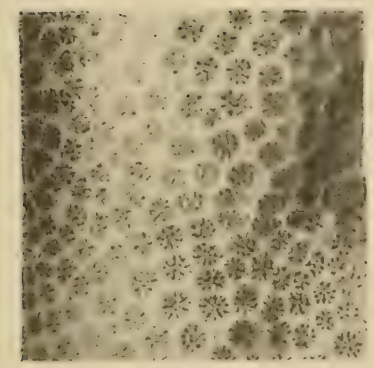

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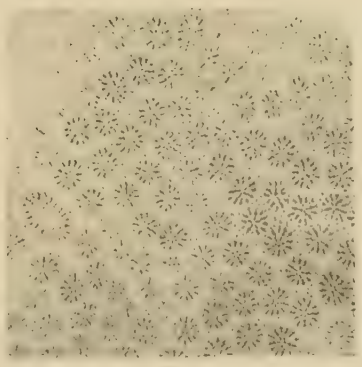

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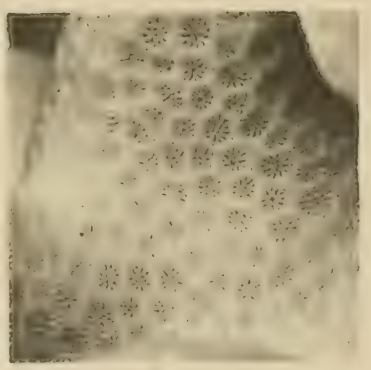

9

PORITES

GREAT BARRIER REEF.

Collo : Morgan & Kidd, Richmond, S.W.

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PORITES.

GROWTH-FORMS FROM THE GREAT BARRIER REEF.

Collo : Morgan & Kidd, Richmond, S.W.

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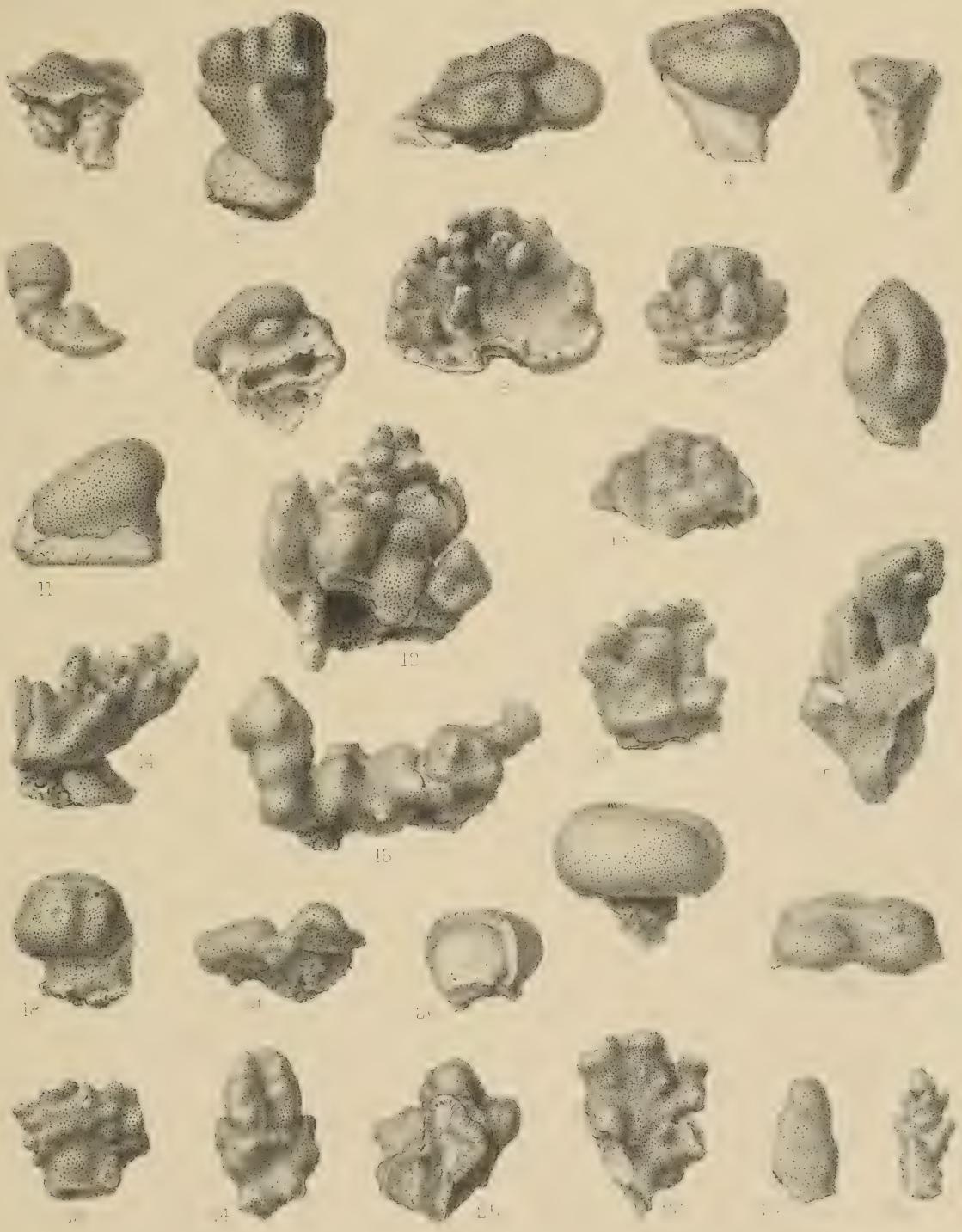
5

PORITES.

GROWTH-FORMS FROM THE GREAT BARRIER REEF

Collo Morgan & Kidd Richmond, S.W.



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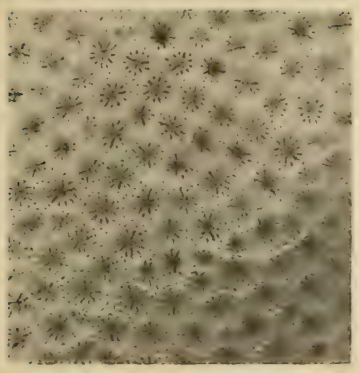
PORITES

GROWTH-FORMS FROM THE GREAT BARRIER REEF



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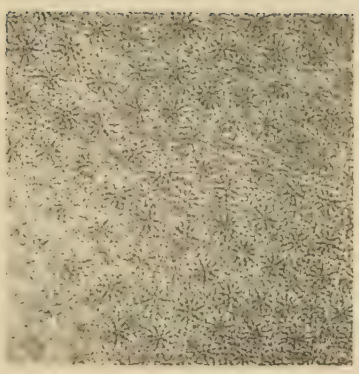

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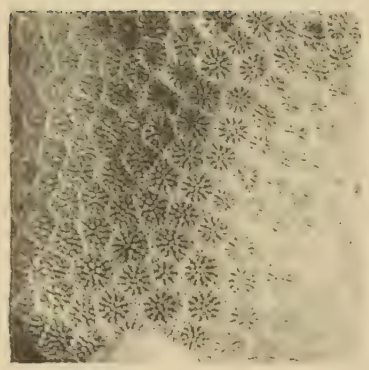

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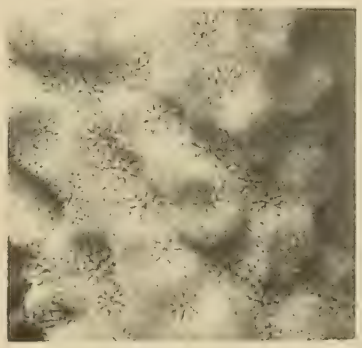

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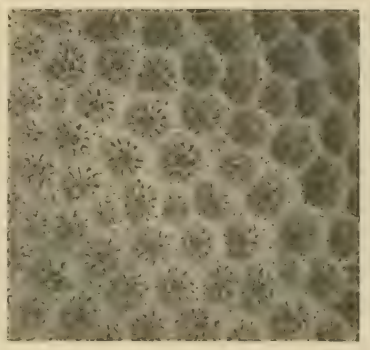

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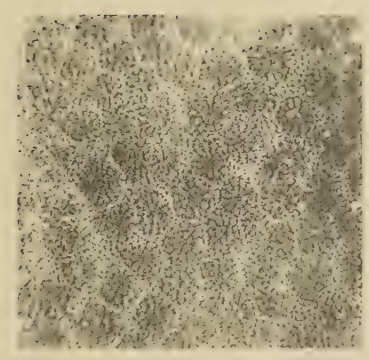

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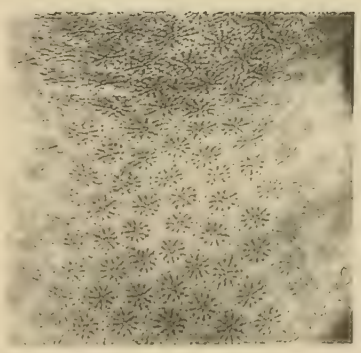

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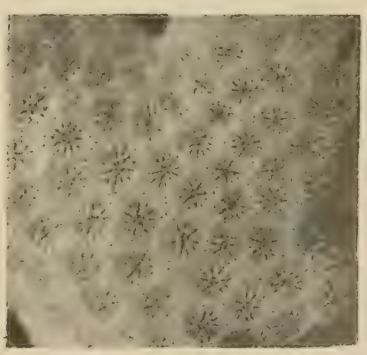
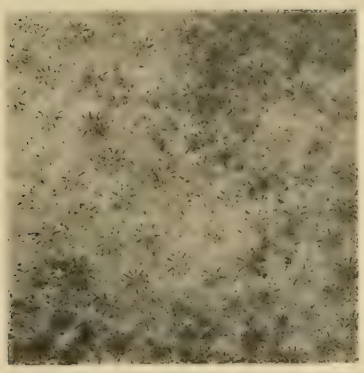


9

PORITES.

1. North East Australia. 2-9 North Australia.

Collo: Morgan & Kidd, Richmond, S.W.



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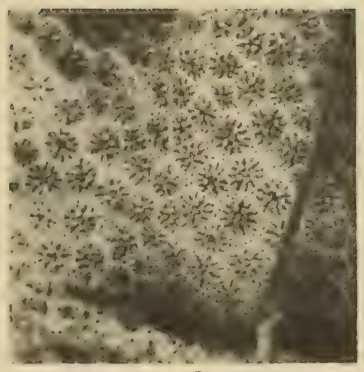

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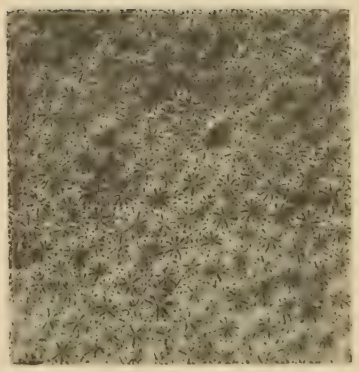

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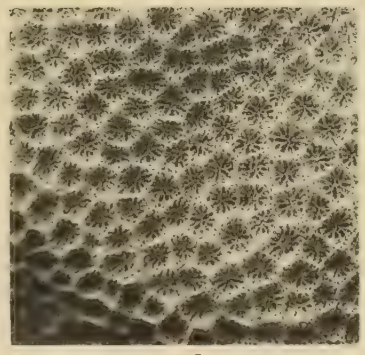

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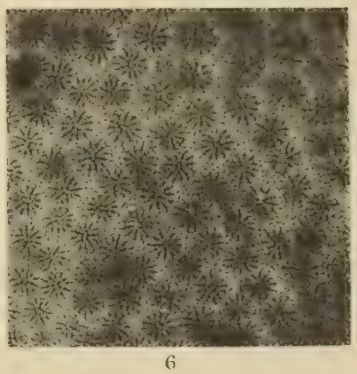

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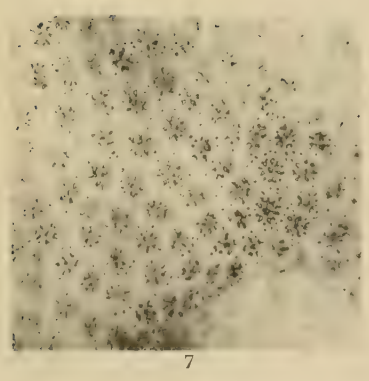

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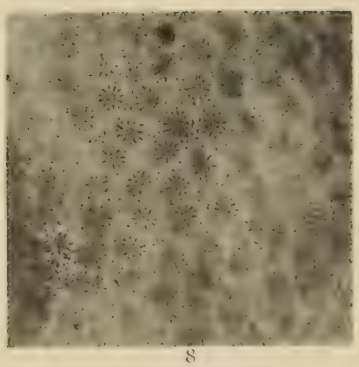

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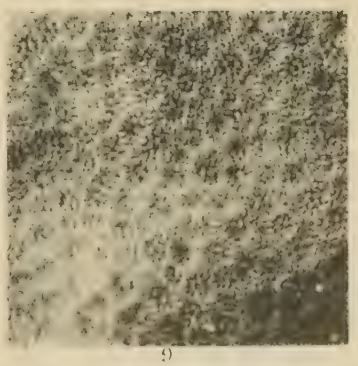
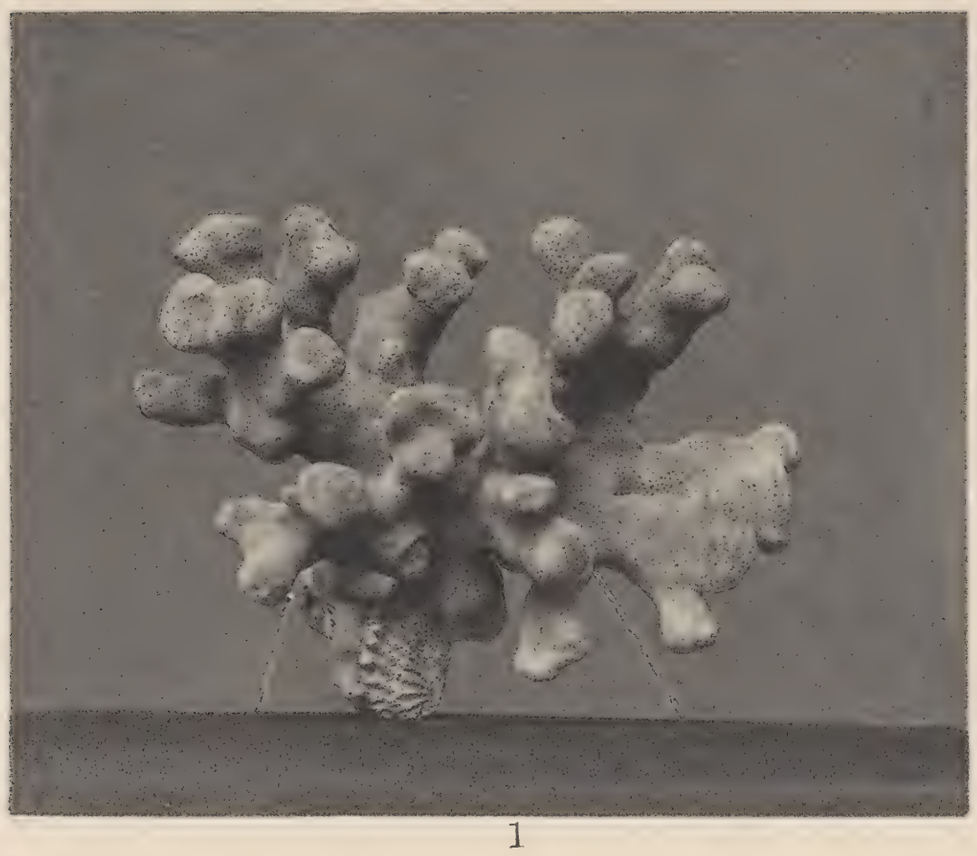


9

PORITES.

NORTH WEST AUSTRALIA.

Collo: Morgan & Kidd. Richmond, S.W



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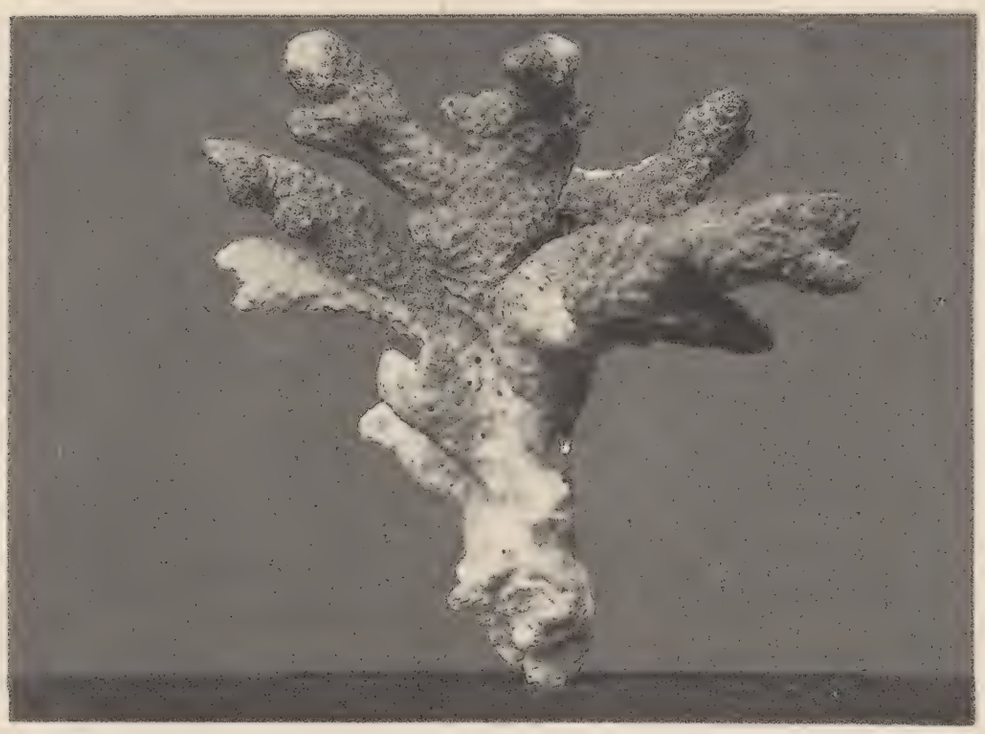

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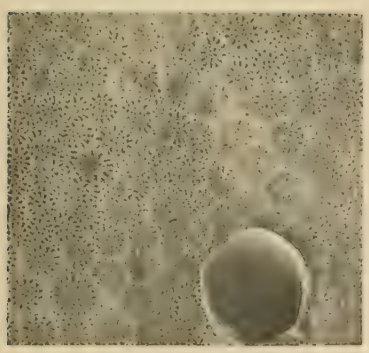
PORITES.

GROWTH FORMS FROM NORTH AND NORTH WEST AUSTRALIA.

«Collo : Morgan & Kidd, Richmond, S.W.



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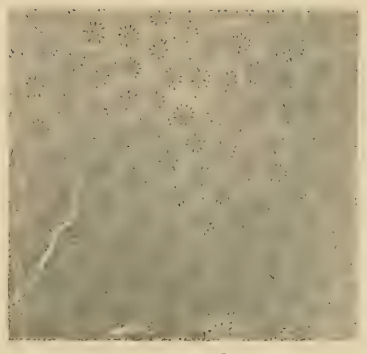

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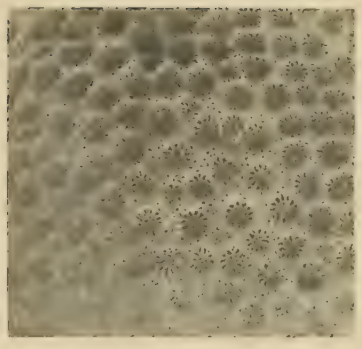

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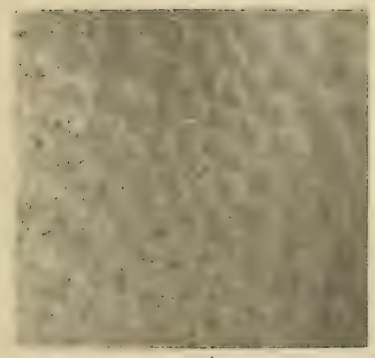

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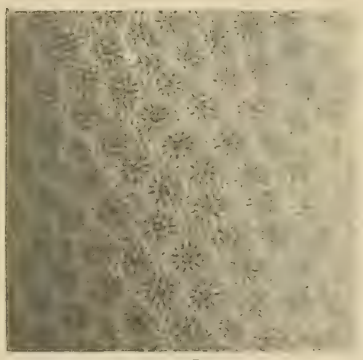

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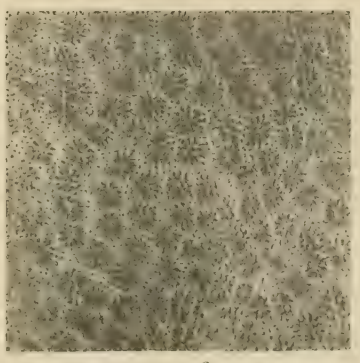

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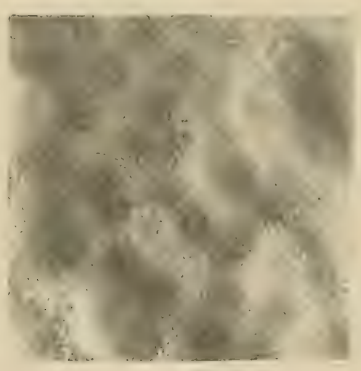


9

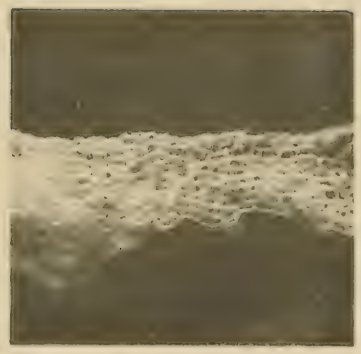
PORITES.

MALAYAN REGION.

1-2. Timor Laut. 3-4. Banda Sea. 5-8. Philippines. 9. China Sea.

Collo: Morgan & Kidd, Richmond S.W.

1



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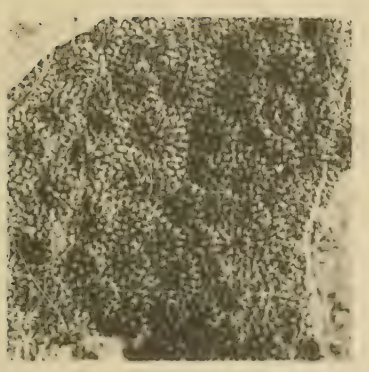

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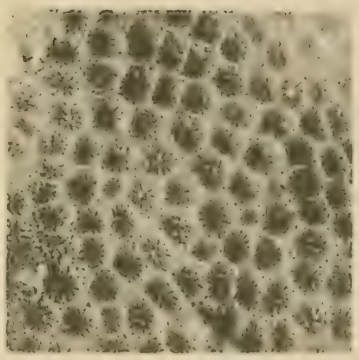

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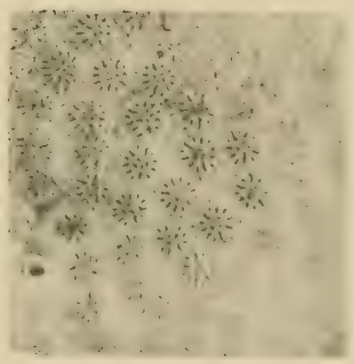

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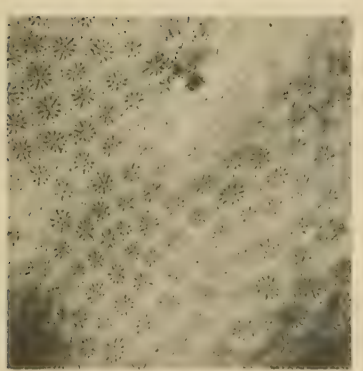

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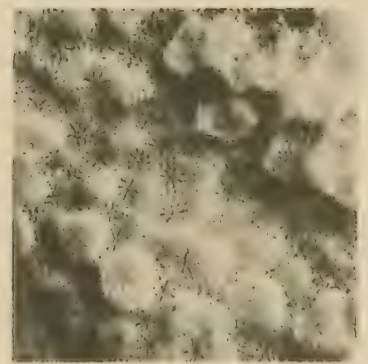

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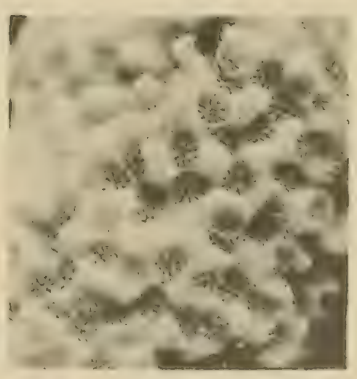


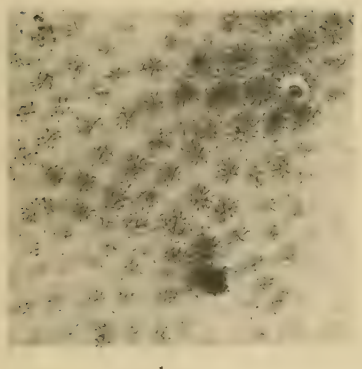
9

PORITES.

MALAYAN REGION.

China Sea.

Collo Morgan & Kidd, Richmond, S.W.



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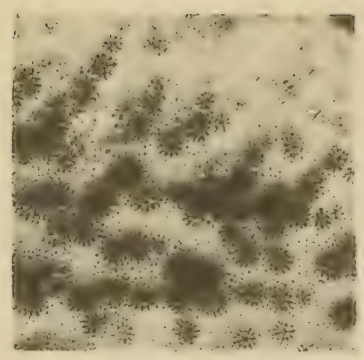

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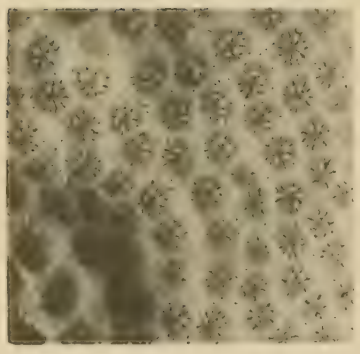

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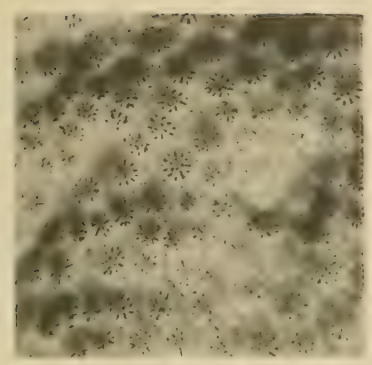

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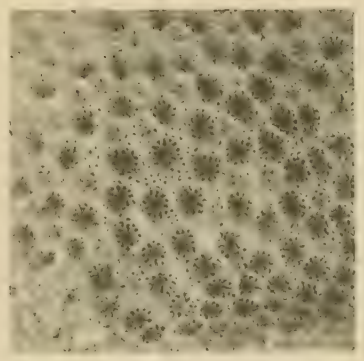

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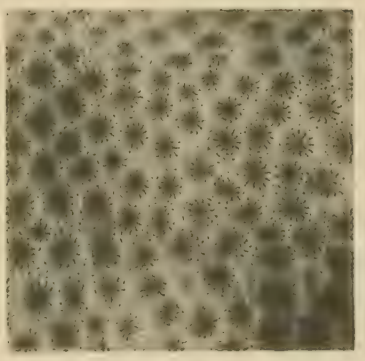

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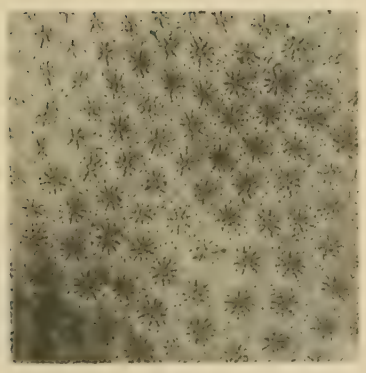

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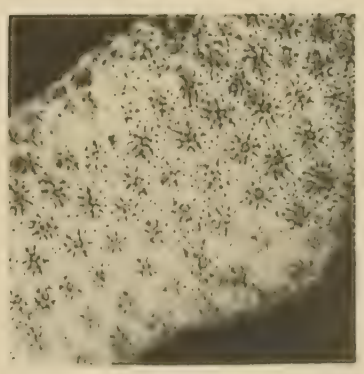

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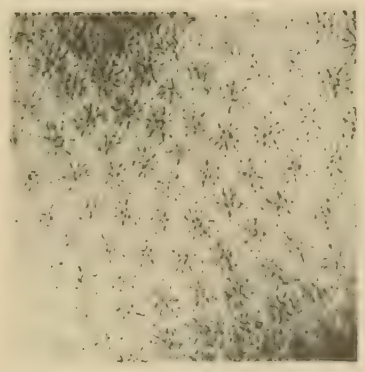


9

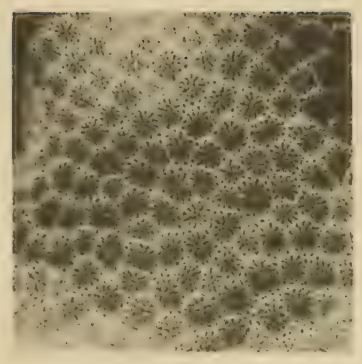
PORITES.

MALAYAN REGION.

China Sea.

Collot Morgan & Kidd, Richmond, S.W.

1



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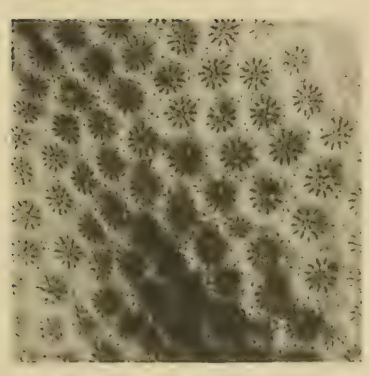

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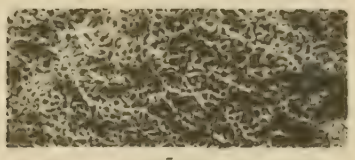

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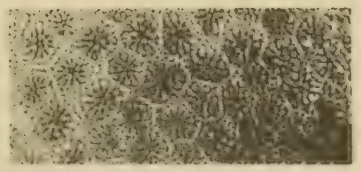

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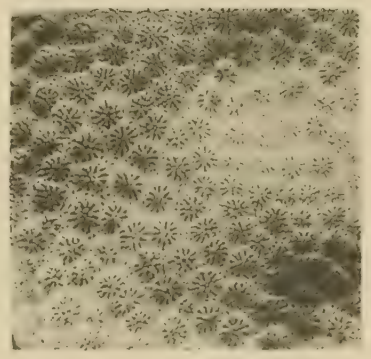

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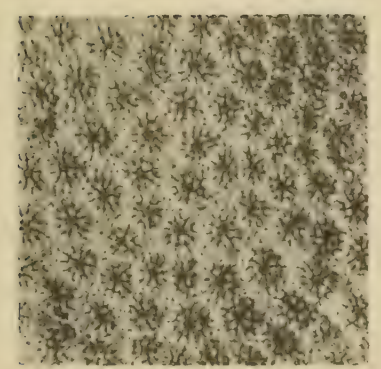

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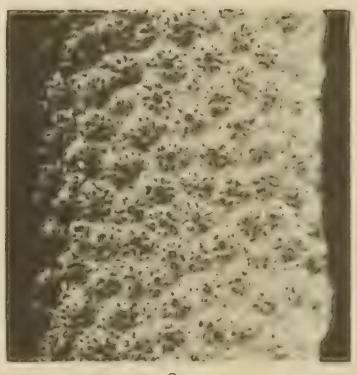

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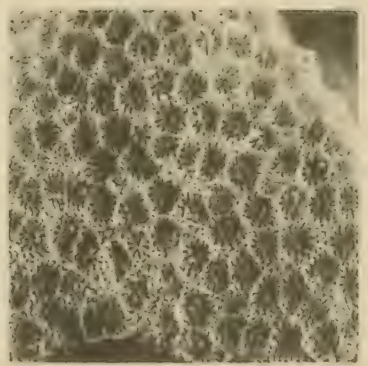


9

PORITES.

THE MALAYAN REGION AND INDIAN OCEAN.

1-7. Singapore. 8. Java Sea. 9. Christmas Island.

Collo: Morgan & Kidd, Richmond, S.W.

1

2

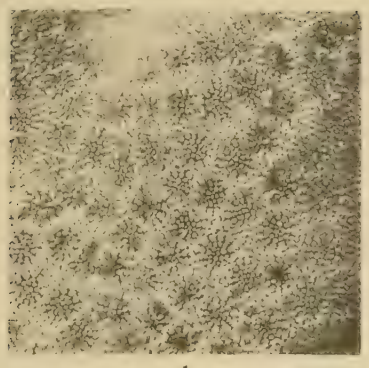
3

4

5

PORITES.

GROWTH FORMS FROM THE MALAYAN REGION.



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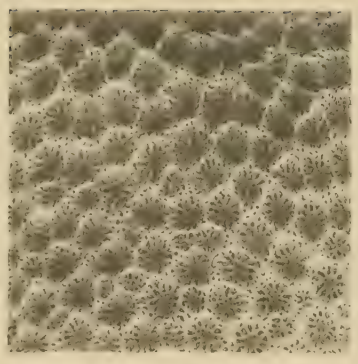

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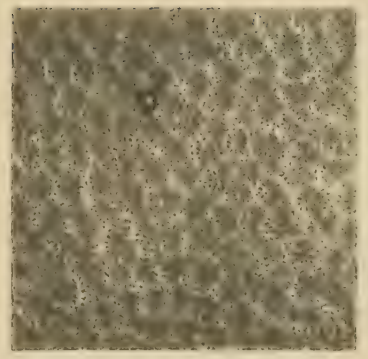

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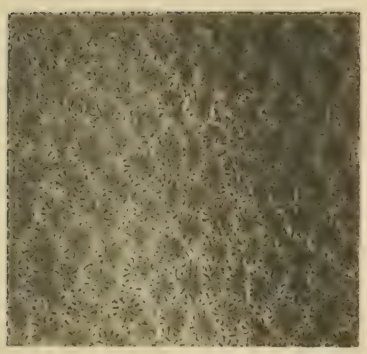

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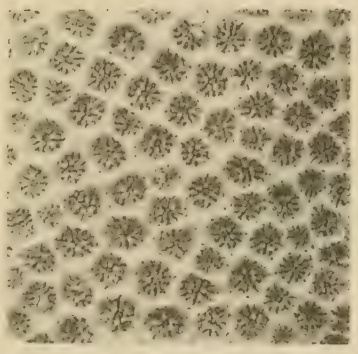

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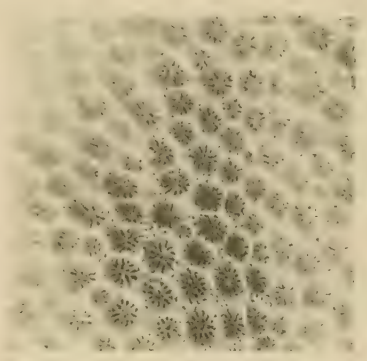

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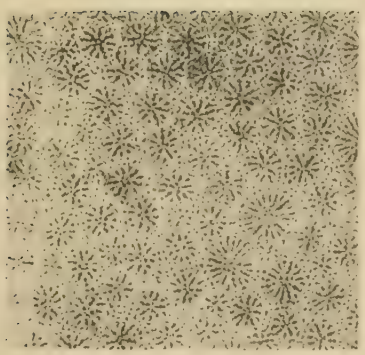

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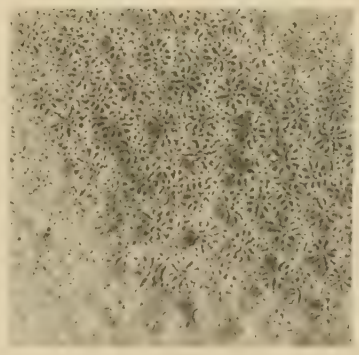

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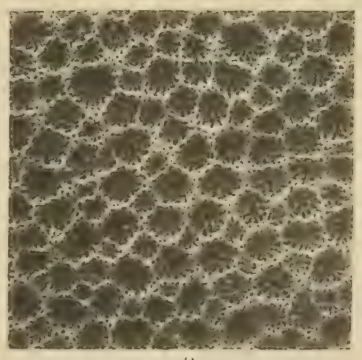


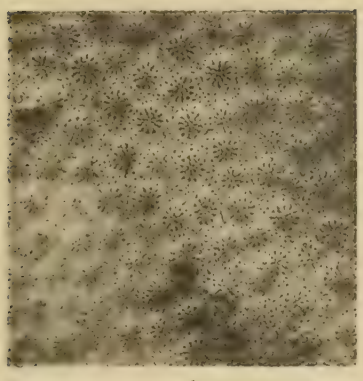
9

PORITES.

INDIAN OCEAN.

1 Kokos Islands. 2-9 Ceylon.

Collo Morgan & Kidd, Richmond, S.W.



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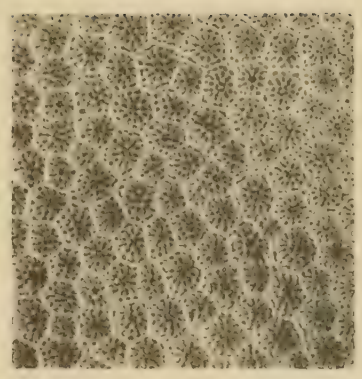

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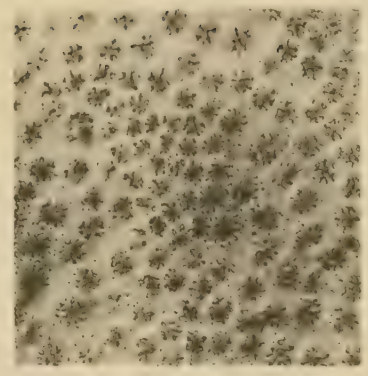

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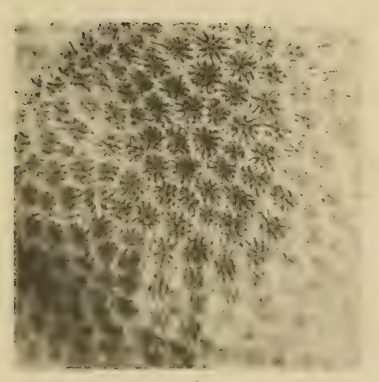

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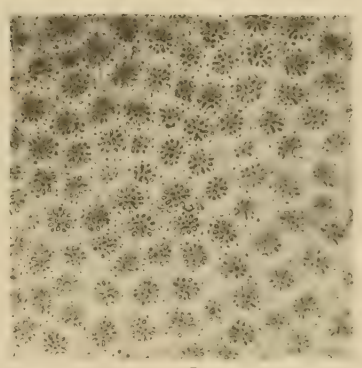

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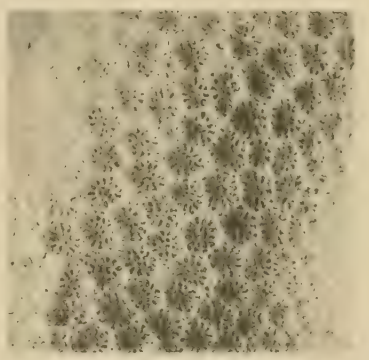

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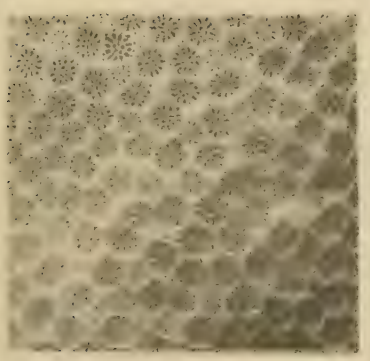

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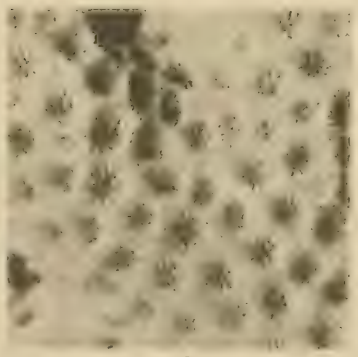

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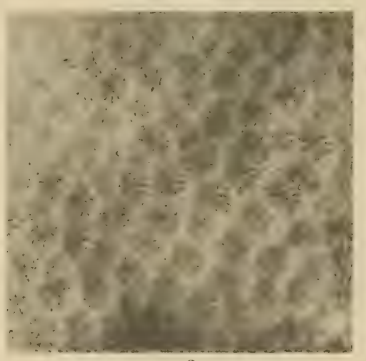


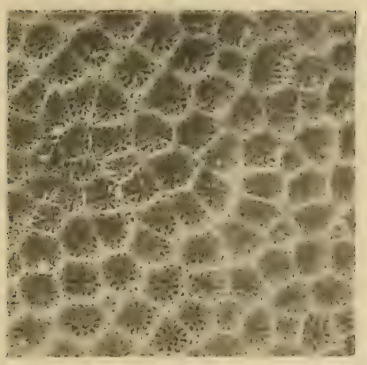
9

PORITES.

INDIAN OCEAN.

1-6 Ceylon. 7-9 Maldives.

Collo: Morgan & Kidd, Richmond, S.W.



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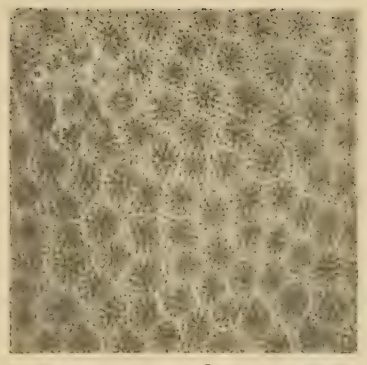

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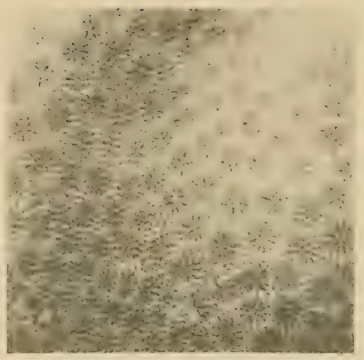

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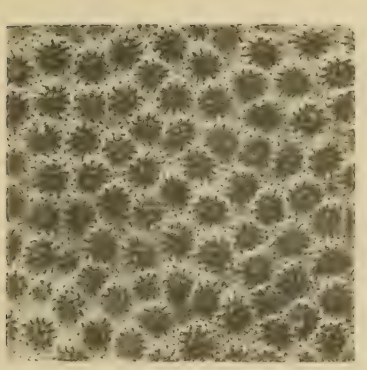

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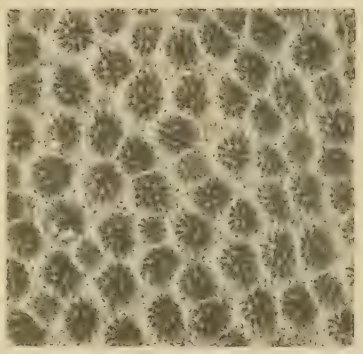

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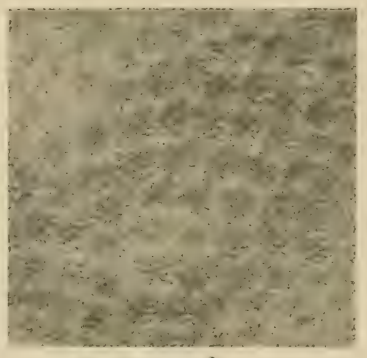

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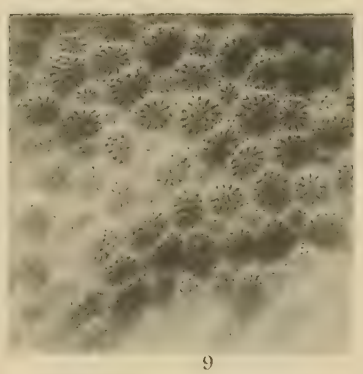


9

PORITES.

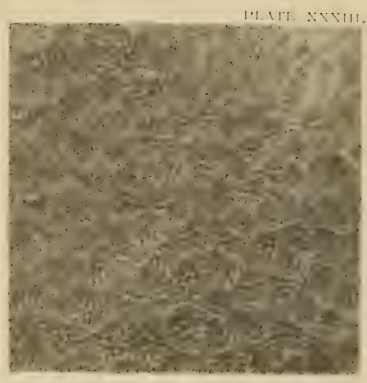
INDIAN OCEAN.

1-3 Diego-Garcia. 4-5 Rodriguez. 6-9 Mauritius.

Collo Morgan & Kidd, Richmond. S W

1

2



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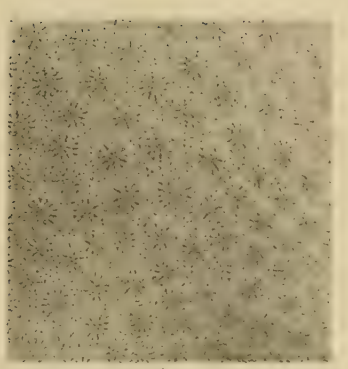

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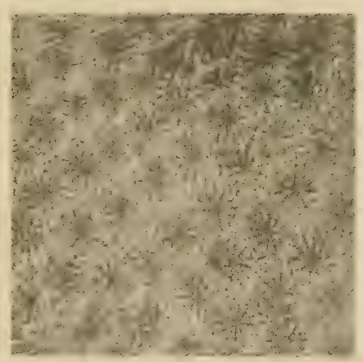

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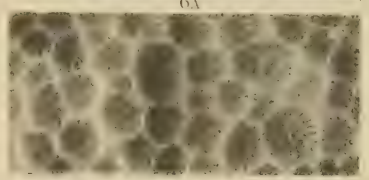

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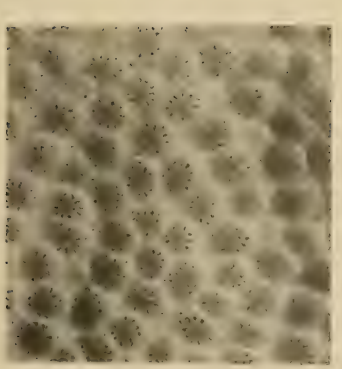

7

8A

8B

9

PORITES.

INDIAN OCEAN AND RED SEA.

1-3 Amirantes. 4-5 Providence Isl. 6A & B Persian Gulf. 7-9 Red Sea.

Collo—Morgan & Kidd, Richmond, S.W.

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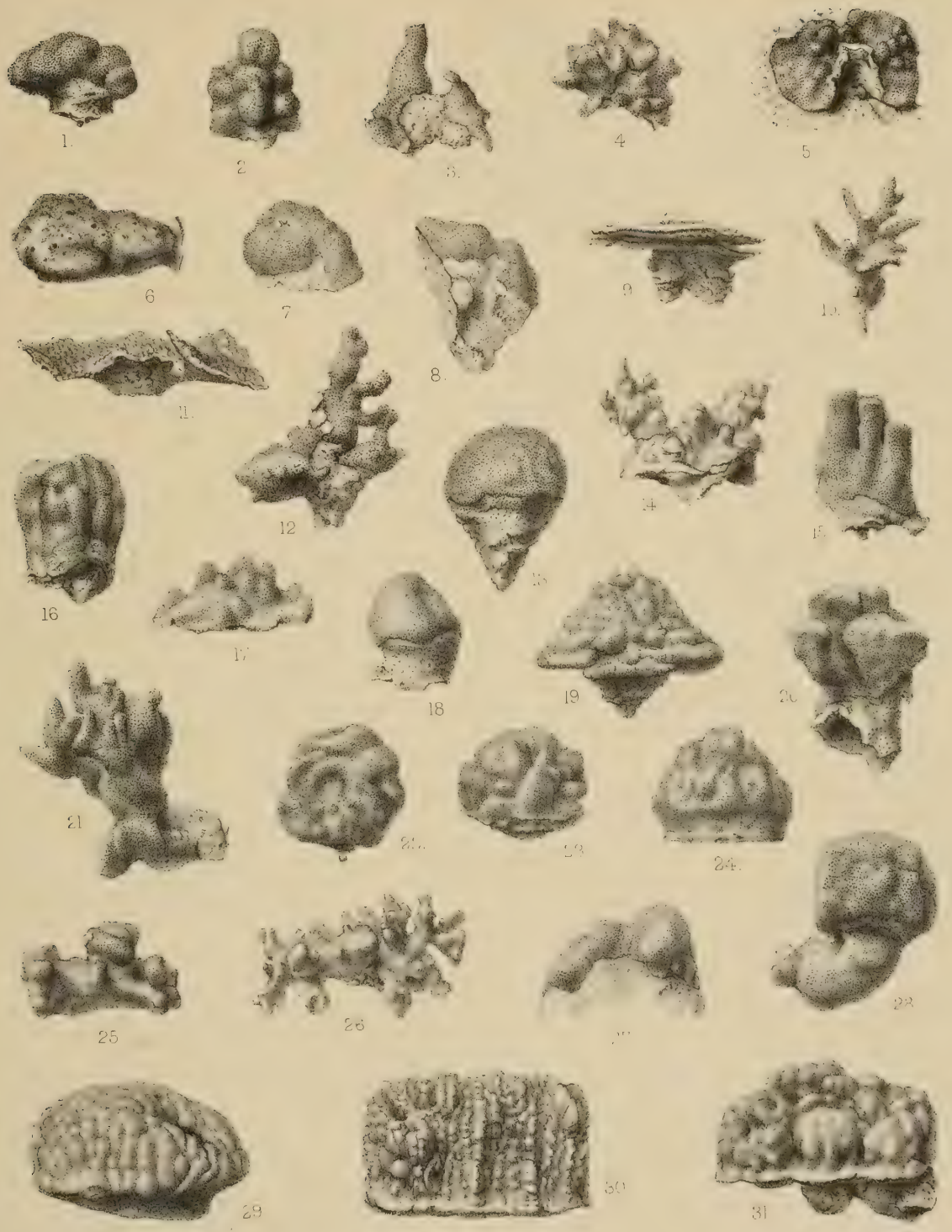
PORITES.

GROWTH-FORMS FROM THE INDIAN OCEAN.



A.T. Hollick del et lith. West, Newman imp.

PORITES.

GROWTH-FORMS FROM THE MALAY ARCHIPELAGO AND INDIAN OCEAN.

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